Courses having focus on employability/ entrepreneurship/ skill development offered by the institution during 2019-20

Course Name : Basic Electronics					
Course Code : ECEN1011					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After going through this course, the students will be able to

1. Categorize different semiconductor materials based on their energy bands and analyze the characteristics of those materials for different doping concentrations based on previous knowledge on semiconductors acquired.
2. Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode both from device and circuit perspectives.
3. Design different application specific circuits associated with diodes operating both in forward and reverse bias.
4. Analyze various biasing configurations of Bipolar Junction Transistor and categorize different biasing circuits based on stability.
5. Categorize different field-effect transistors based on their constructions, physics and working principles and solve problems associated with analog circuits based on operational amplifiers.
6. Design and implement various practical purpose electronic circuits and systems meant for both special purpose and general purpose and analyze their performance depending on the type of required output and subsequently the applied input.

Module I [10 L]

Basic Semiconductor Physics:

Crystalline materials, Energy band theory, Conductors, Semiconductors and Insulators, Concept of Fermi Energy level, intrinsic and extrinsic semiconductors, drift and diffusion currents in semiconductor

Diodes and Diode Circuits:

Formation of p-n junction, Energy Band diagram, forward & reverse biased configurations, V-I characteristics, load line, breakdown mechanisms, Zener Diode and its Application.

Rectifier circuits: half wave & full wave rectifiers: ripple factor, rectification efficiency.

Module II [8 L]

Bipolar Junction Transistors (BJT):

PNP & NPN BJT structures, current components in BJT, CE, CB, CC configurations, V-I Characteristics of CB & CE modes, regions of operation, Base width modulation & Early effect, thermal runaway, Concept of Biasing: DC load line, Q-point, basics of BJT amplifier operation, current amplification factors, different biasing circuits: fixed bias, collector to base bias, voltage divider bias.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

HOD, ECE Department
Heritage Institute of Technology
Kolklata

Module III [9 L]

Field Effect Transistors (FET):

N-channel Junction Field Effect Transistor (JFET) structure & V-I characteristics.

Metal Oxide Semiconductor Field Effect Transistor (MOSFET): enhancement & depletion type MOSFETs (for both n & p channel devices), drain & transfer characteristics.

MOSFET as a digital switch, CMOS inverter, voltage transfer characteristic (VTC), NAND & NOR gate realization using CMOS logic.

Moore's Law, evolution of process node, state of integration (SSI, MSI, LSI, VLSI, ULSI), Classification of Integrated circuits (IC) and their applications.

Module IV [9 L]

Feedback in amplifiers:

Concept of feedback, advantages of negative feedback (qualitative), Barkhausen criteria.

Operational Amplifier:

Ideal OPAMP characteristics, OPAMP circuits: inverting and non-inverting amplifiers, Adder, Subtractor, Integrator, Differentiator, Basic Comparator.

Special Semiconductor Devices:

Light Emitting Diode (LED), Silicon Controlled Rectifier (SCR), Photodiode: Operations, characteristics & applications.

HOD, ECE Department
Heritage Institute of Technology
Kolklata

References:

1. Boylestad & Nashelsky:Electronic Devices & Circuit Theory
2. R.A Gayakwad:Op Amps and Linear IC's, PHI
3. D. Chattopadhyay, P. C Rakshit : Electronics Fundamentals and Applications
4. Adel S. Sedra, Kenneth Carless Smith: Microelectronics Engineering
5. Millman & Halkias: Integrated Electronics.
6. Salivahanan: Electronics Devices & Circuits.
7. Albert Paul Malvino: Electronic Principle.

Course Name : Basic Electronics Laboratory					
Course Code : ECEN1061					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Outcomes:

HOD, ECE Department
Heritage Institute of Technology
Kolkata

1. The students will correlate theory with diode behavior.
2. They will design and check rectifier operation with regulation etc.
3. Students will design different modes with BJT and FET and check the operations.
4. They will design and study adder, integrator etc. with OP-AMPs.

List of Experiments

1. Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multi-metersetc.
2. Familiarization with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs in CB mode
7. Study of I-V characteristics of BJTs in CE mode
8. Study of I-V characteristics of Field Effect Transistors.
9. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
10. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
11. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and Differentiators.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name: BASIC ELECTRICAL ENGINEERING					
Course Code: ELEC1001					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Outcomes

After attending the course, the students will be able to

- Analyse DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.
- Analyse DC Machines; Starters and speed control of DC motors.
- Analyse magnetic circuits.
- Analyse single and three phase AC circuits.
- Analyse the operation of single phase transformers.
- Analyse the operation of three phase induction motors.

Module-I:

DC Network Theorem: Kirchhoff's laws, Nodal analysis, Mesh analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Star-Delta conversion. [6L]

Electromagnetism: Review of magnetic flux, Force on current carrying conductors, Magnetic circuit analysis, Self and Mutual inductance, B-H loop, Hysteresis and Eddy current loss, Lifting power of magnet. [5L]

Module-II

AC single phase system: Generation of alternating emf, Average value, RMS value, Form factor, Peak factor, representation of an alternating quantity by a phasor, phasor diagram, AC series, parallel and series-parallel circuits, Active power, Reactive power, Apparent power, power factor, Resonance in RLC series and parallel circuit. [10L]

Module-III

Three phase system: Generation of three-phase AC power, Balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams, power measurement by two wattmeter method. [4L]

DC Machines: Construction, EMF equation, Principle of operation of DC generator, Open circuit characteristics, External characteristics, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of DC motor. [7L]

Module-IV

Transformer: Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, Open and Short circuit tests, Efficiency, Introduction to three phase transformer. [6L]

Three-phase induction motor: Concept of rotating magnetic field, Principle of operation, Construction, Equivalent circuit and phasor diagram, torque-speed/slip characteristics. [4L]

HOD, EE

Text Books:

1. Basic Electrical engineering, D.P Kothari & I.J Nagrath, TMH, Second Edition
2. Basic Electrical Engineering, V.N Mittle & Arvind Mittal, TMH, Second Edition
3. Basic Electrical Engineering, Hughes
4. Electrical Technology, Vol-I,Vol-II,Surinder Pal Bali, Pearson Publication
5. A Text Book of Electrical Technology, Vol. I & II, B.L. Theraja, A.K. Theraja, S.Chand & Company

Reference Books:

1. Electrical Engineering Fundamentals, Vincent Del Toro, Prentice-Hall
2. Advance Electrical Technology, H.Cotton, Reem Publication
3. Basic Electrical Engineering, R.A. Natarajan, P.R. Babu, Sictech Publishers
4. Basic Electrical Engineering, N.K. Mondal, Dhanpat Rai
5. Basic Electrical Engineering, Nath & Chakraborti
6. Fundamental of Electrical Engineering, Rajendra Prasad, PHI, Edition 2005.

<table>
<tr><td colspan="6">Course Name: BASIC ELECTRICAL ENGINEERING LABORATORY</td></tr>
<tr><td colspan="6">Course Code: ELEC1051</td></tr>
<tr><td rowspan="2">Contact Hours per week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>2</td><td>1</td></tr>
</table>

Course Outcomes: The students are expected to

- Get an exposure to common electrical apparatus and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Apply various network theorems in Electrical Circuits.
- Understand the application of common electrical measuring instruments.
- Understand the basic characteristics of different electrical machines.
- Know the measurement technique various electrical parameters.

List of Experiments:

1. Characteristics of Fluorescent lamps
2. Characteristics of Tungsten and Carbon filament lamps
3. Verification of Thevenin’s & Norton’s theorem.
4. Verification of Superposition theorem
5. Verification of Maximum Power Transfer theorem
6. Calibration of ammeter and voltmeter.
7. Open circuit and Short circuit test of a single phase Transformer.
8. Study of R-L-C Series / Parallel circuit
9. Starting and reversing of speed of a D.C. shunt Motor
10. Speed control of DC shunt motor.
11. No load characteristics of D.C shunt Generators
12. Measurement of power in a three phase circuit by two wattmeter method.

HOD, EE

Course Name : CHEMISTRY-I					
Course Code: CHEM 1001					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

The course outcomes of the subject are

1. Knowledge of understanding the operating principles and reaction involved in batteries and fuel cells and their application in automobiles as well as other sectors to reduce environmental pollution.
2. An ability to analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.for engineering applications.
3. Have knowledge of synthesizing nano materials and their applications in industry, carbon nano tube technology is used in every industry now-a-days.
4. Understanding of bulk properties and processes using thermodynamic considerations.
5 Elementary knowledge of IR, UV, NMR and X-ray spectroscopy is usable in structure elucidation and characterisation of various molecules.
6. Knowledge of electronic effect and stereochemistry for understanding mechanism of the major chemical reactions involved in synthesis of various drug molecules.

MODULE 1

Atomic structure and Wave Mechanics:

Brief outline of the atomic structure, Duel character of electron, De Broglies's equation, the Heisenberg uncertainty principle, brief introduction of quantum mechanics, the Schrodinger wave equation, Hermitian operator, solution of the Schrodinger equation for particle in a one dimensional box, interpretation of the wave function Ψ, concept of atomic orbital.

3**L**

Thermodynamics:

Carnot cycle, 2nd law of thermodynamics, entropy, Clausius inequality, free energy and work function, Clausius Clapeyron Equation, Chemical Potential, Activity and Activity coefficient. Gibbs Duhem Relation.

4**L**

Spectroscopic Techniques & Application

Electromagnetic spectrum: EMR interaction with matter - absorption and emission of radiation.

Principle and application of UV- visible and IR spectroscopy

Principles of NMR Spectroscopy and X-ray diffraction technique **3L**

MODULE 2

Chemical Bonding

Covalent bond, VSEPR Theory, hybridization, molecular geometries, Dipole moment, Intermolecular forces, V.B. and M.O. Theory and its application in Homo and Heteronuclear diatomic molecules, Band theory of solids, Pi-molecular orbitals of ethylene and butadiene.

5**L**

Periodicity

Effective nuclear charge, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro-negativity, inert pair effect.

3

L Ionic Equilibria

Acid Base Equilibria, Salt Hydrolysis and Henderson Equation, Buffer solutions, pH indicator, Common ion Effect, Solubility product, Fractional Precipitation .

2L

MODULE 3

Conductance

Conductance of electrolytic solutions, Strong and Weak electrolytes, effect of temperature and concentration. Kohlrausch’s law of independent migration of ions, transport numbers and hydration of ions. Application of conductance Acid-base and precipitation titration.

3L

Electrochemical Cell

Thermodynamic derivation of Nernst equation, Electrode potential and its application to predict redox reaction; Standard Hydrogen Electrode, Reference electrode, cell configuration, half cell reactions, evaluation of thermodynamic functions; Reversible and Irreversible cells; Electrochemical corrosion.

Electrochemical Energy Conversion: Primary & Secondary batteries, Fuel Cells.

Reaction dynamics

Rate Laws, Order & Molecularity; zero, first and second order

kinetics. Pseudo-unimolecular reaction, Arrhenius equation.

Mechanism and theories of reaction rates (Transition state theory, Collison theory). Catalysis: Homogeneous catalysis (Definition, example, mechanism, kinetics).

3L

MODULE 4

Stereochemistry

Representations of 3- dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

4L

Structure and reactivity of Organic molecule

Inductive effect, resonance, hyperconjugation, electromeric effect, carbocation, carbanion, free radicals, aromaticity. **3L**

Organic reactions and synthesis of drug molecule (4 lectures)

Introduction to reaction mechanisms involving substitution, addition, elimination and oxidation- reduction reactions. Synthesis of commonly used drug molecules.

3L

Text Books

1. Atkins' Physical Chemistry, P.W. Atkins (10^{th}Edition)
2. Organic Chemistry, I. L. Finar, Vol-1 (6^{th}Edition)

3. Engineering Chemistry, Jain &Jain,(16^{th}Edition)
4. Fundamental Concepts of Inorganic Chemistry, A. K. Das, (2^{nd}Edition)
5. Engineering Chemistry -I, GourkrishnaDasmohapatra, (3^{rd}Edition)

Reference Books

1. General & Inorganic Chemistry, R. P. Sarkar
2. Physical Chemistry, P. C. Rakshit, (7^{th}Edition)
3. Organic Chemistry, Morrison &Boyd , (7^{th}Edition)
4. Fundamentals of Molecular Spectroscopy, C.N. Banwell, (4^{th}Edition)
5. Physical Chemistry, G. W. Castellan, (3^{rd}Edition)
6. Basic Stereo chemistry of Organic Molecules, Subrata Sen Gupta, (1^{st}Edition)

09/08/2022

Course Name : CHEMISTRY-I LAB					
Course Code: CHEM 1051					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**1.5**

Course Outcomes:

The course outcomes of the subject are

1. Knowledge to estimate the hardness of water which is required to determine the usability of water used in industries.
2. Estimation of ions like Fe^{2+}, Cu^{2+} and Cl^{-} present in water sample to know the composition of industrial water.
3. Study of reaction dynamics to control the speed and yield of various manufactured goods produced in polymer, metallurgical and pharmaceutical industries.
4. Handling physico-chemical instruments like viscometer, stalagmometer, pH-meter, potentiometer and conductometer.
5. Understanding the miscibility of solutes in various solvents required in paint, emulsion, biochemical and material industries.
6. Knowledge of sampling water can be employed for water treatment to prepare pollution free water.

Experiments:

1. Estimation of iron using KMnO4self indicator.
2. Iodometric estimation of Cu^{2+}.

3. Determination of Viscosity.

4. Determination of surface tension.

5. Adsorption of acetic acid by charcoal.

6. Potentiometric determination of redox potentials.

7. Determination of total hardness and amount of calcium and magnesium separately in a given water sample.
8. Determination of the rate constant for acid catalyzed hydrolysis of ethyl acetate.

9. Heterogeneous equilibrium (determination of partition coefficient of acetic acid in n-butanol and water mixture).
10. Conductometric titration for the determination of strength of a given HCl solution against a standard NaOH solution.
11. pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.

12. Determination of chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

Reference Books:

1. Vogel's Textbook of Quantitative Chemical Analysis-G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney.
2. Advanced Practical Chemistry- S. C. Das
3. Practicals in Physical Chemistry- P. S. Sindhu

09/08/2022

Organic reactions and synthesis of drug molecule: Introduction to reaction mechanisms involving substitution, addition, elimination and oxidation- reduction reactions. Synthesis of commonly used drug molecules.

3. Textbooks

1. Atkins' Physical Chemistry, P.W. Atkins (10^{th} Edition).
2. Organic Chemistry, I. L. Finar, Vol-1 (6^{th} Edition).
3. Engineering Chemistry, Jain & Jain, (16^{th} Edition).
4. Fundamental Concepts of Inorganic Chemistry, A. K. Das, (2^{nd} Edition).
5. Engineering Chemistry -I, Gourkrishna Dasmohapatra, (3^{rd} Edition).

4. Reference Books

1. General & Inorganic Chemistry, R. P. Sarkar.
2. Physical Chemistry, P. C. Rakshit, (7^{th} Edition).
3. Organic Chemistry, Morrison & Boyd, (7^{th} Edition).
4. Fundamentals of Molecular Spectroscopy, C.N. Banwell, (4^{th} Edition).
5. Physical Chemistry, G. W. Castellan, (3^{rd} Edition).
6. Basic Stereo chemistry of Organic Molecules, Subrata Sen Gupta, (1^{st} Edition).

Course Name: Mathematics-I					
Course Code: MATH1101					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

1. Course Outcomes

After completion of the course, students will be able to:

MATH1111.1. Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.
MATH2111.1. Develop the concept of eigen values and eigen vectors.
MATH3111.1. Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.
MATH4111.1. Analyze the nature of sequence and infinite series
MATH5111.1. Choose proper method for finding solution of a specific differential equation.
MATH6111.1. Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

2. Detailed Syllabus

Module 1 [10L]

Matrix: Inverse and rank of a matrix; Elementary row and column operations over a matrix; System of linear equations and its consistency; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigen vectors; Diagonalization of matrices; Cayley Hamilton theorem; Orthogonal transformation.

Module 2 [10L]

Vector Calculus: Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative, Related problems on these topics.

Infinite Series: Convergence of sequence and series; Tests for conver gence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test (statements and related problems on these tests), Raabe's test; Alternating series; Leibnitz's Test (statement, definition); Absolute convergence and Conditional convergence.

Module 3 [10L]

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders: General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods, Method of variation of parameters, Cauchy-Euler equations.

Module 4 [10L]

Calculus of functions of several variables: Introduction to functions of several variables with examples, Knowledge of limit and continuity, Determination of partial derivatives of higher orders with examples, Homogeneous functions and Euler's theorem and related problems up to three variables.

Multiple Integration: Concept of line integrals, Double and triple integrals. Green's Theorem, Stoke's Theorem and Gauss Divergence Theorem.

3. Textbooks
1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 2000.
2. Advanced Engineering Mathematics, E. Kreyszig, John Wiley & Sons, 2006.

4. Reference Books
1. Engineering Mathematics for first year, Veerarajan T., Tata McGraw-Hill, New Delhi, 2008.
2. Higher Engineering Mathematics, Ramana B.V., Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Mathematical Methods for Physics and Engineering, K. F. Riley, M. P. Hobson, S. J. Bence., Cambridge University Press, 23-Mar-2006.
4. Differential Equations, S. L. Ross, Wiley India, 1984.
5. Differential Equations, G.F. Simmons and S.G. Krantz, McGraw Hill, 2007.
6. Vector Analysis (Schaum's outline series): M. R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education).
7. Engineering Mathematics: S. S. Sastry (PHI).
8. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP), Indian Edition.
9. Linear Algebra (Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education).

Course Name: Basic Electrical Engineering					
Course Code: ELEC1001					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

1. Course Outcomes
After completion of the course, students will be able to:

ELEC1101.0. Analyze DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.
ELEC1201.0. Analyze DC Machines; Starters and speed control of DC motors.
ELEC1301.0. Analyze magnetic circuits.
ELEC1401.0. Analyze single and three phase AC circuits.
ELEC1501.0. Analyze the operation of single-phase transformers.
ELEC1601.0. Analyze the operation of three phase induction motors.

1. Detailed Syllabus
Module 1 [11L]
DC Network Theorem: Kirchhoff's laws, Nodal analysis, Mesh analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Star-Delta conversion.
Electromagnetism: Review of magnetic flux, Force on current carrying conductors, Magnetic circuit analysis, Self and Mutual inductance, B-H loop, Hysteresis and Eddy current loss, Lifting power of magnet.

Module 2 [10L]
AC single phase system: Generation of alternating emf, Average value, RMS value, Form factor, Peak factor, representation of an alternating quantity by a phasor, phasor diagram, AC series, parallel and series-parallel circuits, Active power, Reactive power, Apparent power, power factor, Resonance in RLC series and parallel circuit.

Module 3 [11L]
Three phase system: Generation of three-phase AC power, Balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams, power measurement by two wattmeter method.
DC Machines: Construction, EMF equation, Principle of operation of DC generator, Open circuit characteristics, External characteristics, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of DC motor.

Module 4 [10L]
Transformer: Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, Open and Short circuit tests, Efficiency, Introduction to three phase transformers.
Three-phase induction motor: Concept of rotating magnetic field, Principle of operation, Construction, Equivalent circuit and phasor diagram, torque-speed/slip characteristics.

Faraday's Law: Differential form of Faraday's law expressing curl of electric field in terms of time derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi static approximation. Energy stored in a magnetic field.

3. Reference Books

1. Optics –Eugene Hecht Pearson Education India Private Limited.
2. Introduction to Electrodynamics, David J. Griffiths, Pearson Education IndiaLearning Private Limited.
3. Waves and Oscillations by N.K. Bajaj.
4. Principles of Physics, 10ed, David Halliday, Robert Resnick Jearl Walker, Wiley.
5. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press.
6. Classical mechanics, Narayan Rana, Pramod Joag, McGraw Hill Education.
7. Introduction to Classical Mechanics, R Takwale, P Puranik, McGraw Hill Education.
8. Optics, Ghatak, McGraw Hill Education India Private Limited.
9. Refresher Course in B.Sc. Physics –Vol1 and Vol 2 –C.L.Arora.

Course Name: Mathematics-II					
Course Code: MATH1201					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

1. Course Outcomes

After completion of the course, students will be able to:

MATH1211.1. Demonstrate the knowledge of probabilistic approaches to solve wide range of engineering problem.

MATH2211.1. Recognize probability distribution for discrete and continuous variables to quantify physical and engineering phenomenon.

MATH3211.1. Develop numerical techniques to obtain approximate solutions to mathematical problems where analytical solutions are not possible to evaluate.

MATH4211.1. Analyse certain physical problems that can be transformed in terms of graphs and trees and solving problems involving searching, sorting and such other algorithms.

MATH5211.1. Apply techniques of Laplace Transform and its inverse in various advanced engineering problems.

MATH6211.1. Interpret differential equations and reduce them to mere algebraic equations using Laplace Transform to solve easily.

2. Detailed Syllabus

Module 1 [10L]

Basic Probability: Random experiment, Sample space and events, Classical and Axiomatic definition of probability, Addition and Multiplication law of probability, Conditional probability, Bayes' Theorem, Random variables, General discussion on discrete and continuous distributions, Expectation and Variance, Examples of special distribution: Binomial and Normal Distribution.

Module 2 [10L]

Basic Numerical Methods: Solution of non-linear algebraic and transcendental equations: Bisection Method, Newton-Raphson Method, Regula-Falsi Method. Solution of linear system of equations: Gauss Elimination Method, Gauss-Seidel Method, LU Factorization Method, Matrix Inversion Method. Solution of Ordinary differential equations: Euler's Method, Modified Euler's Method, Runge-Kutta Method of 4th order.

Module 3 [10L]

Basic Graph Theory: Graph, Digraph, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Sub-graph, Walk, Path, Circuit, Euler Graph, Cut sets and cut vertices, Matrix representation of a graph, Adjacency and incidence matrices of a graph, Graph isomorphism, Bipartite graph, Dijkstra's Algorithm for shortest path problem. Definition and properties of a Tree, Binary tree and its properties, Spanning tree of a graph, Minimal spanning tree, Determination of spanning trees using BFS and DFS algorithms, Determination of minimal spanning tree using Kruskal's and Prim's algorithms.

Module 4 [12L]

Laplace Transformation: Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations. Introduction to integral transformation, Functions of exponential order, Definition and existence of Laplace Transform(LT) (statement of initial and final value theorem only), LT of elementary functions, Properties of Laplace Transformations , Evaluation of sine , cosine and exponential integrals using LT, LT of periodic and step functions, Definition and properties of inverse LT, Convolution Theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODEs with constant coefficients (initial value problem) using LT.

3. Textbooks

1. Advanced Engineering Mathematics, E. Kreyszig, Wiley Publications.
2. Engineering Mathematics, B.S. Grewal, S. Chand & Co.

4. Reference Books

1. Introduction to Probability and Statistics for Engineers and Scientists, S. Ross, Elsevier.
2. Introductory methods of Numerical Analysis, S.S. Sastry, PHI learning.
3. Introduction to Graph Theory, D. B. West, Prentice-Hall of India.

Course Name: Programming for Problem Solving					
Course Code: CSEN1001					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN1101.1. Understand and remember functions of the different parts of a computer.

CSEN2101.1. Understand and remember how a high-level language (C programming language, in this course) works, different stages a program goes through.

CSEN3101.1. Understand and remember syntax and semantics of a high-level language (C programming language, in this course).

CSEN4101.1. Understand how code can be optimized in high-level languages.

CSEN5101.1. Apply high-level language to automate the solution to a problem.

CSEN6101.1. Apply high-level language to implement different solutions for the same problem and analyze why one solution is better than the other.

2. Detailed Syllabus

Module 1 [10L]

Fundamentals of Computer: History of Computers, Generations of Computers, Classification of Computers.

Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Basic Concepts of Assembly language, High level language, Compiler and Assembler.

Binary & Allied number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2's complement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII. IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double- 64 bit).

Basic concepts of operating systems like MS WINDOWS, LINUX.

How to write algorithms & draw flow charts.

Module 2 [10L]

Basic Concepts of C: C Fundamentals: The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions: Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Standard input and output, formatted output -- printf, formatted input scanf.

Flow of Control: Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

Module 3 [10L]

Program Structures in C: Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes - auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables; C preprocessor (macro, header files), command line arguments; Arrays and Pointers: One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality; String and character arrays; C library string functions and their use.

Module 4 [10L]

User defined data types and files: Basic of structures; structures and functions; arrays of structures.

Files – text files only, modes of operation. File related functions – fopen(), fclose(), fscanf(), fprintf(), fgets(), fputs(), fseek(), ftell().

Course Name: WORKSHOP /MANUFACTURING PRACTICES					
Course Code: MECH 1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	1	**0**	**4**	**5**	**3**

Course Outcomes:

Upon completion of this course

1. The students will gain knowledge of the differentmanufacturing processes which are commonly employed in the industry, to fabricatecomponents using different materials.
2.The students will be able to fabricatecomponents with their own hands.
3.They will also get practical knowledge of the dimensional accuracies and dimensionaltolerances possible with different manufacturing processes.
4.By assembling different components, they will be able to produce small devices oftheir interest.
5. The students will be able to describe different components and processes of machine tools.
6. The students will be able to apply the knowledge of welding technology and they can perform arc and gas welding to join the material.

(i) Lectures & videos: (13 hours)
Detailed contents
1. Introduction on Workshop and Safety Precautions. **(1 lecture)**
2. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**
3. CNC machining, Additive manufacturing **(1 lecture)**
4. Fitting operations & power tools **(1 lecture)**
5. Electrical & Electronics **(1 lecture)**
6. Carpentry **(1 lecture)**
7. Plastic moulding, glass cutting **(1 lecture)**
8. Metal casting **(1 lecture)**
9. Welding (arc welding & gas welding), brazing **(2 lecture)**
10. Viva-voce **(1 lecture)**

(ii) Workshop Practice :(52 hours)[L : 0; T:0 ; P : 4 (2 credits)]

1. Machine shop **(12 hours)**
2. Fitting shop **(8 hours)**
3. Carpentry **(4 hours)**
4. Electrical & Electronics **(4 hours)**
5. Welding shop **(Arc welding 4 hrs + gas welding 4 hrs)** **(8 hours)**
6. Casting **(4 hours)**
7. Smithy **(4 hours)**
8. Plastic moulding& Glass Cutting **(4 hours)**
9. Sheet metal Shop **(4 hours)**

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Suggested Text/Reference Books:

(i) Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.

(ii) Kalpakjian S. And Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.

(iii)Gowri P. Hariharan and A. Suresh Babu,”Manufacturing Technology – I” Pearson Education, 2008.

(iv) Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998.

(v) Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGrawHill House, 2017.

09/08/2022

Course Name: ENGINEERING GRAPHICS & DESIGN					
Course Code: MECH 1052					
Contact Hours per week:	L	T	P	Total	Credit Points
	1	0	4	5	3

Course Outcomes:

After going through the course, the students will be able to

1. Discuss the fundamental concept of engineering drawing.
2. Implement various standards and symbols followed in engineering drawing.
3. Develop the concept of projection used in engineering graphics.
4. Construct the projected views of a 3-D object into a 2-D plane with the help of orthographic and isometric projections.
5. Appraise the sectional view and the true shape of the surface of a regular object.
6. Demonstrate the use of an engineering drawing software (Auto CAD).

Lecture Plan (13 L)

1. Importance and principles of engineering drawing (1 L)
2. Concepts of Conic sections and Scale (1 L)
3. Introduction to concept of projection (Projections of points, lines and surfaces) (4 L)
4. Definitions of different solids and their projections (1 L)
5. Section of solids and sectional view (1 L)
6. Isometric projection (2 L)
7. Introduction to CAD (2 L)
8. Viva Voce (1 L)

Detailed contents of Lab hours (52 hrs)

Module 1: Introduction to Engineering Drawing covering**,**
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lines, lettering & dimensioning, Conic section like Ellipse (General method only); Involute; Scales – Plain, Diagonal.

(4 hrs + 4 hrs)

Module 2: Orthographic Projections covering**,**
Principles of Orthographic Projections - Conventions - Projections of Points and lines inclined to both planes; Projections on Auxiliary Planes. Projection of lamina.

(4 hrs+4 hrs + 4 hrs)

Module 3: Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views.

(4 hrs + 4 hrs)

Module 4: Sections and Sectional Views of Right Angular Solids covering**,**
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids.

(4 hrs)

Module 5: Isometric Projections covering**,**
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

(4 hrs + 4 hrs)

Module 6: Overview of Computer Graphics covering,
listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.

(4 hrs)

Module 7: Customisation& CAD Drawing
consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

(2 hrs)

Module 8: Annotations, layering & other functions covering
applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation.

(2 hrs)

Module 9: Demonstration of a simple team design project that illustrates
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame.

(4 hrs)

References:

1. Bhatt, N.D., Panchal V.M. & Ingle P.R., (2014) "Elementary Engineering Drawing" ;Charotan Publishing House
2. Narayana, K.L. and KannaaiahP "Engineering Graphics"; TMH
3. Lakshminarayanan, V. and VaishWanar, R.S "Engineering Graphics" Jain Brothers.
4. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Edication.
5. Agarwal B. & Agarwal C. M. (2012), Engineering graphics, TMH Publications

Course Name: PHYSICS I					
Course Code: PHYS 1001					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Outcomes:

After successfully completing this course the students will be able to:

1. Understand and apply Vector Calculus as tool for solving different physical problems.
2. Analyze the nature of central forces and rotating frame phenomenon to understand basic space science and real world applications understand basic space science and real world applications
3. Interpret the different types of oscillatory motion and resonance
4. Apply fundamental theories and technical aspect in the field of electricity and magnetism in solving real world problems in that domain magnetism in solving real world problems in that domain.
5. Understand the Electrical and Magnetic properties of different types of materials for scientific and technological use materials for scientific and technological use
6. Develop Analytical & Logical skill in handling problems in technology related domain

Module 1 : Mechanics (7+5)= 12L

Elementary concepts of grad, divergence and curl. Potential energy function; F=-grad V, Equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, Curl of a force field; Central forces ; conservation of angular momentum; Energy equation and energy diagrams; elliptical, parabolic and hyperbolic orbit; Kepler Problem; Application : Satellite manoeuvres .

Non-inertial frames of reference; rotating coordinate system; five term acceleration formula- centripetal and coriolis accelerations; applications: Weather system, Foucault pendulum.

Module 2 : Optics (4 +3+ 5) = 12 L

Oscillatory Motion:

Damped harmonic motion – Over damped, critically damped and lightly damped oscillators; Forced oscillation and resonance. Electrical equivalent of mechanical oscillator, Wave equation, plane wave solution.

Optics:

Elementary features of polarization of light waves. Double refraction, Production and analysis of linearly, elliptic and Circularly polarized light, Polaroid and application of polarizations.: Polarimeter.

Laser & Fiber Optics:

Characteristics of Lasers, Spontaneous and Stimulated Emission of Radiation, Meta-stable State, Population Inversion, Lasing Action, Einstein's Coefficients and Relation between them, Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers.
Fiber optics - principle of operation, numerical aperture, acceptance angle, Single mode , graded indexed fiber.

Module 3: **Electrostatics (8+4) = 12 L**
Electrostatics in free space
Calculation of electric field and electrostatic potential for a charge distribution, Divergence and curl of electrostatic field, Laplace's and Poisson's equation for electrostatic potential. Boundary conditions of electric field and electrostatic potential. Method of images , energy of a charge distribution and its expression in terms of electric field.

Electrostatics in a linear dielectric medium
Electrostatic field and potential of a dipole, Bound charges due to electric polarization, Electric displacement, Boundary conditions on displacement, Solving simple electrostatic problem in presence of dielectric – point charge at the centre of a dielectric sphere, charge in front of dielectric slab, Dielectric slab and dielectric sphere in uniform electric field.

Module 4: **(6+3+3)= 12L**
Magnetostatics :
Biot-Savart law, divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; equation for vector potential and it's solutions for given current densities .

Magnetostatics in a linear magnetic medium:
Magnetization and associated bound currents; Auxiliary magnetic field $\vec{H}$; boundary conditions on $\vec{B}$ and $\vec{H}$. Solving for magnetic field due to simple magnet like a bar magnet; Magnetic susceptibility ; ferromagnetic , paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Faraday's Law:
Differential form of Faraday's law expressing curl of electric field in terms of time derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi static approximation. Energy stored in a magnetic field.

Books of reference :

1. Optics – **Eugene Hecht** Pearson Education India Private Limited
2. Introduction to Electrodynamics, **David J. Griffiths**, Pearson Education IndiaLearning Private Limited
3. Waves and Oscillations by **N.K. Bajaj**
4. Principles of Physics, 10ed, **David Halliday, Robert Resnick Jearl Walker** , Wiley

5. Electricity, Magnetism, and Light, **Wayne M. Saslow**, Academic Press
6. Classical mechanics, **Narayan Rana, Pramod Joag**, McGraw Hill Education
7. Introduction to Classical Mechanics, **R Takwale, P Puranik**, McGraw Hill Education
8. Optics, **Ghatak**, McGraw Hill Education India Private Limited
9. Refresher Course in B.Sc. Physics – Vol1 and Vol 2 – **C.L.Arora**

09/08/2022

<table>
<tr><td colspan="6">Course Name: PHYSICS I LAB</td></tr>
<tr><td colspan="6">Course Code: PHYS 1051</td></tr>
<tr><td rowspan="2">Contact Hours per week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>3</td><td>1.5</td></tr>
</table>

Course Outcomes:

1. Transform the theoretical knowledge into experimental set design
2. Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
3. Analyze the result obtained through experiment.
4. Gain knowledge of new concept in the solution of practical oriented problems and to understand more deep knowledge about the solution to theoretical problems.
5. Understand measurement technology, usage of new instruments and real time applications in engineering studies.
6. Develop skills to impart practical knowledge in real time solution.

Minimum of six experiments taking at least one from each of the following four groups :

Group 1 :Experiments in General Properties of matter

1. Determination of **Young's modulus** by **Flexure Method**
2. Determination of **bending moment** and **shear force** of a rectangular beam of uniform cross- section.
3. Determination of **modulus of rigidity** of the material of a rod by **static method**
4. Determination of **rigidity modulus** of the material of a **wire by dynamic method.**
5. Determination of **coefficient of viscosity** by Poiseulle's capillary flow method.

Group 2: Experiments in Optics

1. Determination of **dispersive power** of the material of a prism
2. Determination of wavelength of light by **Newton's ring** method.
3. Determination of wavelength of light by **Fresnel's biprism method.**
4. Determination of the **wavelength of a given laser** source by diffraction method

Group 3: Electricity & Magnetism experiments

1. Determination of **dielectric constant** of a given dielectric material.
2. Determination of resistance of **ballistic galvanometer by half deflection** method and study of variation of **logarithmic decrement** with series resistance.
3. Determination of the **thermo-electric power** at a certain temperature of the given thermocouple.
4. Determination of **specific charge (e/m)** of electron.

Group 4: Quantum Physics Experiments

1. Determination of **Planck's constant**.
2. Determination of **Stefan's radiation** constant.

3. Verification of **Bohr's atomic orbital** theory through **Frank-Hertz experiment**.
4. Determination of **Rydberg constant** by studying **Hydrogen/ Helium** spectrum.
5. Determination of **Hall co-efficient of semiconductors.**
6. Determination of **band gap** of semiconductors.
7. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

Text Books

1. Advanced Practical Physics (vol. 1 and vol. 2)
   B. Ghosh and K. G. Mazumdar.
2. Advanced course in practical physics
   D. Chattopadhyay and P.C. Rakshit.

09/08/2022

3. Textbooks

1. Advanced Engineering Mathematics, E. Kreyszig, Wiley Publications.
2. Engineering Mathematics, B.S. Grewal, S. Chand & Co.

4. Reference Books

1. Introduction to Probability and Statistics for Engineers and Scientists, S. Ross, Elsevier.
2. Introductory methods of Numerical Analysis, S.S. Sastry, PHI learning.
3. Introduction to Graph Theory, D. B. West, Prentice-Hall of India.

Course Name: Programming for Problem Solving					
Course Code: CSEN1001					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN1101.1. Understand and remember functions of the different parts of a computer.

CSEN2101.1. Understand and remember how a high-level language (C programming language, in this course) works, different stages a program goes through.

CSEN3101.1. Understand and remember syntax and semantics of a high-level language (C programming language, in this course).

CSEN4101.1. Understand how code can be optimized in high-level languages.

CSEN5101.1. Apply high-level language to automate the solution to a problem.

CSEN6101.1. Apply high-level language to implement different solutions for the same problem and analyze why one solution is better than the other.

2. Detailed Syllabus

Module 1 [10L]

Fundamentals of Computer: History of Computers, Generations of Computers, Classification of Computers.

Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Basic Concepts of Assembly language, High level language, Compiler and Assembler.

Binary & Allied number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2's complement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII. IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double- 64 bit).

Basic concepts of operating systems like MS WINDOWS, LINUX.

How to write algorithms & draw flow charts.

Module 2 [10L]

Basic Concepts of C: C Fundamentals: The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions: Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Standard input and output, formatted output -- printf, formatted input scanf.

Flow of Control: Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

Module 3 [10L]

Program Structures in C: Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes - auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables; C preprocessor (macro, header files), command line arguments; Arrays and Pointers: One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality; String and character arrays; C library string functions and their use.

Module 4 [10L]

User defined data types and files: Basic of structures; structures and functions; arrays of structures.

Files – text files only, modes of operation. File related functions – fopen(), fclose(), fscanf(), fprintf(), fgets(), fputs(), fseek(), ftell().

Dr. Subhashis Majumder

3. Textbooks
1. Schaum's outline of Programming with C – Byron Gottfried.
2. Teach Yourself C- Herbert Schildt.
3. Programming in ANSI C – E Balagurusamy.

4. Reference Books
1. C: The Complete Reference – Herbert Schildt.
2. The C Programming Language- D.M.Ritchie, B.W. Kernighan.

Course Name: Business English					
Course Code: HMTS1202					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**2**

1. Course Outcomes
After completion of the course, students will be able to:
HMTS1212.1. Acquire competence in using English language to communicate.
HMTS2212.1. Be aware of the four essential skills of language usage-listening, speaking, reading and writing.
HMTS3212.1. Be adept at using various modes of written communication at work.
HMTS4212.1. Attain the skills to face formal interview sessions.

2. Detailed Syllabus
Module 1 [6L]
Grammar (Identifying Common Errors in Writing): Subject-verb agreement, Noun-pronoun agreement, Misplaced Modifiers, Articles, Prepositions, Redundancies.

Module 2 [6L]
Basic Writing Strategies: Sentence Structures, Use of phrases and clauses in sentences, Creating coherence, Organizing principles –accuracy, clarity, brevity, Techniques for writing precisely, Different styles of writing: descriptive, narrative, expository, Importance of proper punctuation.

Module 3 [8L]
Business Communication- Scope & Importance: Writing Formal Business Letters: Form and Structure-Parts of a Business letter, Business Letter Formats, Style and Tone, Writing strategies.
Organizational Communication: Agenda & minutes of a meeting, Notice, Memo, Circular.
Organizing e-mail messages, E-mail etiquette.
Job Application Letter: Responding to Advertisements and Forced Applications, Qualities of well-written Application Letters: The You-Attitude, Length, Knowledge of Job Requirement, Reader-Benefit Information, Organization, Style, Mechanics – Letter Plan: Opening Section, Middle Section, Closing Section.
Resume and CV: Difference, Content of the Resume – Formulating Career Plans: Self Analysis, Career Analysis, Job Analysis, Matching Personal Needs with Job Profile – Planning your Resume – Structuring the Resume: Chronological Resume, The Functional Resume, Combination of Chronological and Functional Resume, Content of the Resume: Heading, Career Goal or Objectives, Education, Work Experience, Summary of Job Skills/Key Qualifications, Activities, Honors and Achievements, Personal Profile, Special Interests, References.

Module 4 [6L]
Writing skills: Comprehension: Identifying the central idea, inferring the lexical and contextual meaning, comprehension passage – practice. Paragraph Writing: Structure of a paragraph, Construction of a paragraph, Features of a paragraph, Writing techniques/developing a paragraph.
Précis: The Art of Condensation-some working principles and strategies. Practice sessions of writing précis of given passages.
Essay Writing: Characteristic features of an Essay, Stages in Essay writing, Components comprising an Essay, Types of Essays-Argumentative Essay, Analytical Essay, Descriptive Essays, Expository Essays, Reflective Essays.

3. Reference Books
1. Theories of Communication: A Short Introduction, Armand Matterlart and Michele Matterlart, Sage Publications Ltd.
2. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA: Advanced Communication Designs.
3. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.
4. Kalia, S. & Agarwal, S. Business Communication,Wiley India Pvt. Ltd., New Delhi, 2015.
5. Mukherjee, H.S., Business Communication- Connecting at work., Oxford University Press.2nd Edition.2015.
6. Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011.

Course Code: CSEN1051					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**4**	**4**	**2**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN1151.1. To write simple programs relating to arithmetic and logical problems.
CSEN2151.1. To be able to interpret, understand and debug syntax errors reported by the compiler.
CSEN3151.1. To implement conditional branching, iteration (loops) and recursion.
CSEN4151.1. To decompose a problem into modules (functions) and amalgamating the modules to generate a complete program.
CSEN5151.1. To use arrays, pointers and structures effectively in writing programs.
CSEN6151.1. To be able to create, read from and write into simple text files.

2. Detailed Syllabus

Topic 1: LINUX commands and LINUX based editors
Topic 2: Basic Problem Solving
Topic 3: Control Statements (if, if-else, if-elseif-else, switch-case)
Topic 4: Loops - Part I (for, while, do-while)
Topic 5: Loops - Part II
Topic 6: One Dimensional Array
Topic 7: Array of Arrays
Topic 8: Character Arrays/ Strings
Topic 9: Basics of C Functions
Topic 10: Recursive Functions
Topic 11: Pointers
Topic 12: Structures
Topic 13: File Handling

3. Textbooks

1. Schaum's outline of Programming with C – Byron Gottfried.
2. Teach Yourself C- Herbert Schildt.
3. Programming in ANSI C – E Balagurusamy.

4. Reference Books

1. C: The Complete Reference – Herbert Schildt.
2. The C Programming Language- D.M.Ritchie, B.W. Kernighan.

Course Name: Workshop /Manufacturing Practices					
Course Code: MECH1051					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**4**	**5**	**3**

1. Course Outcomes

After completion of the course, students will be able to:

MECH1151.1. The students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
MECH2151.1. The students will be able to fabricate components with their own hands.
MECH3151.1. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
MECH4151.1. By assembling different components, they will be able to produce small devices of their interest.
MECH5151.1. The students will be able to describe different components and processes of machine tools.
MECH6151.1. The students will be able to apply the knowledge of welding technology and they can perform arc and gas welding to join the material.

2. Detailed Syllabus

Lecture [13 Hours]

1. Introduction on Workshop and Safety Precautions. (1 L)
2. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 L)
3. CNC machining, Additive manufacturing (1 L)

Department of Humanities

Syllabus

Paper Name: Communication for Professionals (2018-19)

Paper code: HMTS-1011

3L/Week /3credit

Course Outcome

Students will be able to

1. Write business letters and reports
2. Communicate in an official and formal environment.
3. Effectively use the various channels of communication at work place.
4. Use language as a tool to build bridges and develop interpersonal relations in multi-cultural environment.
5. Learn to articulate opinions and views with clarity.
6. Use various techniques of communication for multiple requirements of globalized workplaces

Module- I (9hrs.)

Introduction to Linguistics

- Phonetics- Vowel and Consonant Sounds (Identification & Articulation)
- Word- stress, stress in connected speech
- Intonation (Falling and Rising Tone)
- Voice Modulation
- Accent Training
- Vocabulary Building
- The concept of Word Formation
- Root words from foreign languages and their use in English
- Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives
- Synonyms, Antonyms and standard abbreviations

Module- II (10hrs.)

Communication Skills

- Definition, nature & attributes of Communication
- Process of Communication
- Models or Theories of Communication

Suparna Chakraborti

- Types of Communication
- Levels or Channels of Communication
- Barriers to Communication

Module- III (10hrs.)

Professional Writing Skills

- Letter Writing : Importance, Types , Process, Form and Structure, Style and Tone
- Proposal Writing: Purpose, Types of Proposals, Structure of Formal Proposals.
- Report Writing: Importance and Purpose, Types of Reports, Report Formats, Structure of Formal Reports, Writing Strategies.

Module- IV (10hrs.)

Communication skills at Work

- Communication and its role in the workplace
- Benefits of effective communication in the workplace
- Common obstacles to effective communication
- Approaches and Communication techniques for multiple needs at workplace: persuading, convincing, responding, resolving conflict, delivering bad news, making positive connections,
- Identify common audiences and design techniques for communicating with each audience

Text Books:

1 Kumar,S. &Lata, P. Communication Skills, OUP, New Delhi2011
2 Rizvi,Ashraf,M. Effective Technical Communication, Mc Graw Hill Education(India) Pvt. Ltd..Chennai,2018
3 Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011

Reference Books:

1. Theories of Communication: A Short Introduction, Armand Matterlart and Michele Matterlart, Sage Publications Ltd.
2. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA: Advanced Communication Designs.
3. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.

Suparna Chakraborty

Department of Humanities

Syllabus

Paper Name: Professional Communication Lab (2018-19)

Paper code: HMTS 1061

2P/week/1Credit)

Course Outcome:

Students will be able to

1 .Communicate in an official and formal environment.

2. Effectively communicate in a group and engage in relevant discussion.

3. Engage in research and prepare presentations on selected topics.

4 .Understand the dynamics of multicultural circumstances at workplace and act accordingly.

5. Organize content in an attempt to prepare official documents.

6. Appreciate the use of language to create beautiful expressions

Detailed Syllabus

Module- I (4hrs)

- Techniques for Effective Speaking
- Voice Modulation: Developing correct tone
- Using correct stress patterns: word stress, primary stress, secondary stress
- Rhythm in connected speech

Module- II (6hrs.)

Effective Speaking and Social awareness

The Art of Speaking

- Encoding Meaning Using Nonverbal Symbols
- How to Improve Body Language
- Eye Communication, Facial Expression, Dress and Appearance
- Posture and Movement, Gesture, Paralanguage
- Encoding meaning using Verbal symbols: How words work and how to use words
- Volume, Pace, Pitch and Pause
- Cross-Cultural Communication : Multiple aspects/dimensions of culture
- Challenges of cross-cultural communication
- Improving cross-cultural communication skills at workplace.

Suparna Chakraborti

Module- III (6hrs)

- Group Discussion: Nature and purpose
- Characteristics of a successful Group Discussion
- Group discussion Strategies: Getting the GD started, contributing systematically, moving the discussion along, promoting optimal participation, Handling conflict, Effecting closure.

Module- IV (10hrs.)

Professional Presentation Skills

- Nature and Importance of Presentation skills
- Planning the Presentation: Define the purpose, analyze the Audience, Analyze the occasion and choose a suitable title.
- Preparing the Presentation: The central idea, main ideas, collecting support material, plan visual aids, design the slides
- Organizing the Presentation: Introduction-Getting audience attention, introduce the subject, establish credibility, preview the main ideas, Body-develop the main idea, present information sequentially and logically, Conclusion-summaries, re-emphasize, focus on the purpose, provide closure.
- Improving Delivery: Choosing Delivery methods, handling stage fright
- Post-Presentation discussion: Handling Questions-opportunities and challenges.

References:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3rd Ed., 2004
3. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999
4. R. Anand, Job Readiness For IT & ITES- A Placement and Career Companion, , McGraw Hill Education.2015
5. Malhotra, A., Campus Placements, McGraw Hill Education.2015

Suparna Chakraborti

<u>**Department of Humanities**</u>

<u>**Syllabus**</u>

Paper Name: BUSINESS ENGLISH (2018-19)

Paper Code: HMTS 1202

2L/week

Credit: 2

<u>Course Outcome:</u>

The learner will

1. Acquire competence in using English language to communicate.

2. Be aware of the four essential skills of language usage-listening, speaking, reading and writing.

3. Be adept at using various modes of written communication at work.

4. Attain the skills to face formal interview sessions.

5. Write reports according to various specifications.

6. Acquire the skill to express with brevity and clarity

<u>Detailed Syllabus</u>

<u>Module- I</u> (5hrs.)

Grammar (Identifying Common Errors in Writing)

- Subject-verb agreement
- Noun-pronoun agreement
- Misplaced Modifiers
- Articles
- Prepositions
- Redundancies

<u>Module- II</u> (6hrs.)

- Basic Writing Strategies
- Sentence Structures
- Use of phrases and clauses in sentences
- Creating coherence
- Organizing principles –accuracy, clarity, brevity
- Techniques for writing precisely

Suparna Chakraborti.

- Different styles of writing: descriptive, narrative, expository
- Importance of proper punctuation

Module- III (8hrs)

- Business Communication- Scope & Importance
- Writing Formal Business Letters: Form and Structure- Parts of a Business letter, Business Letter Formats, Style and Tone, Writing strategies.
- Organizational Communication: Agenda & minutes of a meeting, Notice, Memo, Circular
- Organizing e-mail messages, E-mail etiquette
- Job Application Letter: Responding to Advertisements and Forced Applications, Qualities of well-written Application Letters: The You-Attitude, Length, Knowledge of Job Requirement, Reader-Benefit Information, Organization, Style, Mechanics – Letter Plan: Opening Section, Middle Section, Closing Section
- Resume and CV: Difference, Content of the Resume – Formulating Career Plans: Self Analysis, Career Analysis, Job Analysis, Matching Personal Needs with Job Profile – Planning your Resume – Structuring the Resume: Chronological Resume, The Functional Resume, Combination of Chronological and Functional Resume, Content of the Resume: Heading, Career Goal or Objectives, Education, Work Experience, Summary of Job Skills/Key Qualifications, Activities, Honors and Achievements, Personal Profile, Special Interests, References

Module- IV (5hrs)

Writing skills

- Comprehension: Identifying the central idea, inferring the lexical and contextual meaning, comprehension passage - practice
- Paragraph Writing: Structure of a paragraph, Construction of a paragraph, Features of a paragraph, Writing techniques/ developing a paragraph.
- Précis: The Art of Condensation- some working principles and strategies. Practice sessions of writing précis of given passages.
- Essay Writing: Characteristic features of an Essay, Stages in Essay writing, Components comprising an Essay, Types of Essays-Argumentative Essay, Analytical Essay, Descriptive Essays, Expository Essays, Reflective Essays

Text Books:

1) Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011.
2) Mukherjee, H.S., Business Communication- Connecting at work., , Oxford University Press. 2nd Edition.2015
3) Kalia, S. &Agarwal,S. Business Communication, Wiley India Pvt. Ltd., New Delhi, 2015

Suparna Chakraborti

Reference Books

1. Theories of Communication: A Short Introduction, Armand Matterlart and Michele Matterlart, Sage Publications Ltd.
2. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA: Advanced Communication Designs.
3. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.

Suparna Chakraborti.

Department of Humanities

Syllabus

Paper Name: Language Lab (2018-19).

Paper Code: HMTS-1252

2P/week

Credit: 1

Course Outcome:

The learner will

1. Acquire the techniques to become an effective listener.
2. Acquire the skill to become an effortless speaker.
3. Organize and present information for specific audience.
4. Communicate to make a positive impact in professional and personal environment.
5. Engage in research and prepare authentic, formal, official documents.
6. Acquire reading skills for specific purpose.

Detailed Syllabus

Module- I (4hrs)

Listening Skills

- Principles of Listening: Characteristics, Stages.
- Types of Listening: Passive listening, Marginal or superficial listening, Projective Listening, Sensitive or Empathetic Listening, Active or Attentive listening.
- Guidelines for Effective Listening
- Barriers to Effective Listening
- Listening Comprehension

Module- II (8hrs)

- Interviewing
  Types of Interviews, Format for Job Interviews: One-to-one and Panel Interviews, Telephonic Interviews, Interview through video conferencing.
- Interview Preparation Techniques, Frequently Asked Questions, Answering Strategies, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews.

Module- III (5hrs)

Suparna Chakraborti

- Public Speaking: The Speech Process: The Message, The Audience, The Speech Style, Encoding, Feedback.
- Characteristics of a good speech : content and delivery, structure of a speech
- Modes of delivery in public speaking: Impromptu, Extemporaneous, Prepared or Memorized, Manuscript.
- Conversation: Types of conversation: formal and informal, Strategies for effective conversation, Improving fluency.
- Situational conversation practice: Greetings and making introductions, Asking for information and giving instructions, agreeing and disagreeing.
- Conversational skills in the business scenario: One-to-one and Group communication, Gender and Culture Sensitivity, Etiquette, Sample Business Conversation, Telephonic Conversation

Module- IV (7hrs)

Presentation Skills

- Speaking from a Manuscript, Speaking from Memory, Impromptu Delivery, Extemporaneous Delivery, Analyzing the Audience, Nonverbal Dimensions of Presentation
- Organizing the Presentation: The Message Statement, Organizing the Presentation: Organizing the Speech to Inform, The Conclusion, Supporting Your Ideas – Visual Aids: Designing and Presenting Visual Aids, Selecting the Right Medium.
- Project Team/Group Presentations

Reference Books:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3rd Ed., 2004
3. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999
4. Sen, S.,Mahendra,A. & Patnaik,P., Communication and Language Skills, Cambridge University Press, 2015
5. Locker,Kitty O. Business and Administrative Communication McGraw-Hill/ Irwin.
6. Chaney,L.and Martin,J., Intercultural Business Communication. Prentice Hall

Suparna Chakrabarti

Course Name : Analog Circuits					
Course Code : ECEN2101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

After going through this course, the students will be able to

1. Apply the previous knowledge gathered from Basic Electrical and Basic Electronics papers.
2. Understand the concepts of BJT, MOSFET and biasing techniques of BJT and MOSFET based amplifier circuits.
3. Analyze frequency response of amplifier circuits.
4. Design different types sinusoidal oscillators and multivibrator circuits.
5. Construct algebraic equations based amplifier and analog computers using OP-AMP
6. Design stable high-gain amplifier circuits.

MODULE 1: Analog Signals and Devices [9L]

Basic concepts and device biasing [5L]:

Analog, discrete and digital signals. Diode: piecewise-linear model, clipping and clamping operation. BJT biasing circuits, Q-point and stability.

Small Signal analysis of Amplifiers [4L]:

Small signal (h-parameter and re model) analysis of BJT CE mode amplifier circuit (derive input impedance, output impedance, voltage gain, current gain for the amplifiers).

MODULE 2: Oscillators and Frequency Responses of Amplifiers [9L]

Frequency Responses of Amplifiers [2L]:

Frequency response of CE mode RC-coupled amplifier; effect of external and parasitic capacitors on cut-off frequencies.

Feedback & Oscillator Circuits [7L]:

Concept of feedback, Effects of negative feedback in amplifiers, Oscillators circuits: Phase-shift, Wien-Bridge, Hartley, Colpitt and crystal Oscillators.

MODULE 3: Operational Amplifiers (OPAMPs) [7L]

Fundamentals of OPAMP [4L]:

Basic building blocks of OPAMP: Differential Amplifiers, Current source and current mirror circuits. Types of differential amplifiers, AC and DC analysis of differential amplifiers; Characteristics of an ideal OPAMP.

Applications of OPAMP [3L]:

Inverting and non-inverting OPAMP amplifiers, Log-antilog amplifiers, Instrumentation amplifier, Precision rectifiers, basic comparator, Schmitt Trigger.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

MODULE 4: Analog Circuit Applications [7L]

Power Amplifiers [4L]:

Concepts and operations of Class A, B and AB amplifiers; Calculation of DC power, AC power and efficiency of these amplifiers.

Applications Analog IC [3L]:

Description of 555 Timer IC, astable and mono-stable operations using 555. Study of 78XX and 79XX voltage regulator ICs.

Books:

HOD, ECE Department
Heritage Institute of Technology
Kolklata

1. Microelectronic Circuits by Adel S. Sedra, Kenneth C. Smith
2. Electronics Devices and Circuits by Robert L. Boylestad, Louis Nashelskey
3. Fundamentals of Microelectronics by Behzad Razavi
4. Integrated electronics by Jacob Millman, Christos C. Halkias

Course Name : Analog Circuits Laboratory					
Course Code : ECEN2151					
Contact Hours per week	L	T	P	Tota l	Credit Points
	0	0	2	2	1

Course Outcomes:

HOD, ECE Department
Heritage Institute of Technology
Kolklata

The students, after finishing the course, will be able to:

1. Study and compare frequency responses of amplifiers.
2. Design different timer circuits with 555 IC.
3. Design rectifiers and measure rectifier parameters.
4. Generate various waveforms using OP AMPs.

List of experiments:

Experiments using discrete components

1. Study of frequency response of RC coupled amplifier circuit.
2. Study of astable multi-vibrator using 555 timer IC.
3. Study of monostable multi-vibrator using 555 timer IC.
4. Study of full wave and half wave precision rectifier circuits.
5. Study of Wien-Bridge oscillator circuit.
6. Study of Phase Shift oscillator circuit.
7. Study of astable multi-vibrator using OPAMP.
8. Study of Triangular wave generator circuit using OPAMP.
9. Study of Schmitt trigger circuit.
10. Study of fixed voltage regulator circuits using 78XX and 79XX ICs.

Experiments using ASLKv2010StarterKit

11. Negative feedback amplifiers and instrumentation amplifiers to measure parameters like time response, frequency response, DC transfer characteristics,
12. Study of analog filters like LPF, HPF, BPF and BSF
13. Study of VCO and PLL
14. Automatic gain / volume control (AGC/AVC)
15. PC based Oscilloscope

HOD, ECE Department
Heritage Institute of Technology
Kolklata

Course Name : Circuit and Network Theory					
Course Code : ECEN2102					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes

1. Apply the previous knowledge gathered from Basic Electrical Engineering for understanding the basic concepts of this subject.
2. Solve problems in various electric circuits using Network Theorems.
3. Analyze complex circuits in Laplace domain.
4. Understand the application of Graph theory to solve various network behaviour.
5. Evaluate the output of various Two port network without going through the detailed configuration.
6. Design various types of filters using SPICE software.

Module-I

Network equations: Concepts of voltage source and current source, Formulation of Node & Mesh equations. Loop and node variable analysis of transformed circuits. Network Theorems: Thevenin's, Norton's, Superposition, Maximum Power Transfer Theorem, Reciprocity theorem applied to circuits containing dependent sources. [5L]

Resonant Circuits: Series and Parallel resonance, Impedance and Admittance Characteristics, Quality Factor, Half Power Points, Bandwidth, Phasor diagrams. [4L]

Coupled Circuits: Coefficient of coupling, Dot convention, Analysis of coupled circuits. [2L]

Module-II [8 L]

Laplace Transform: Concept of complex frequency. Properties of Laplace transform linearity, differentiation, integration, initial value theorem and final value theorem. Transform of standard periodic and non-periodic waveforms. Circuit elements and their transformed equivalents, Independent and dependent sources and equivalence of sources, treatment of mutual couplings in t & s domain. Transient and steady state response of RL, RC, LC and RLC with or without stored energy. Concept of natural frequency and damping. Sketching transient response, determination of time domain specifications. Concept of Convolution theorem and its application. [8L]

Module-III [9L]

Graph theory: Graph of network: Concept of path, tree, tree branch, tree link, loop, tie set and cut set. Incidence Matrix, tie-set Matrix and f-cut set matrix and their properties. Loop currents and node-pair potentials, formulation of loop and node equilibrium equations in view of graph theory.[4L]

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Two port networks: Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and inverse hybrid parameters. Inter relation between parameters. Inter connection between two port networks. Driving point & transfer impedance & admittance. [5L]

Module-IV [8L]

Filter Circuits: Concept of filters, Classification of filters. Analysis and synthesis of Active Low pass, High pass, Band pass and Band reject filters using operational amplifier. Filter approximations: Butterworth, Chebyshev filters. [5L]

SPICE: Structure of a SPICE program, active and passive device/element statements, different study like DC analysis, transient analysis and ac analysis statement in SPICE. Plotting and printing statement, input and output Impedance calculation using SPICE, voltage and current controlled components in SPICE.[3L]

Total: 36L

Text Books:

1. Networks and Systems, D. Roy Chowdhury, New Age International Publishers
2. Circuit theory, Dr. Abhijit Chakrabarty, Dhanpat Rai & Co Pvt. Ltd.
3. Network Analysis, M.E. Valkenburg, Pearson Education .
4. Fundamental of Electric circuit theory, D. Chattopadhay& P.C. Rakshit, S. Chand.

Reference Books:

1. Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly& S.M. Durbin,The Mc Graw Hill Company.
2. Modern Network Analysis, F.M.Reza&S.Seely, McGraw Hill.

HOD, ECE Department
Heritage Institute of Technology
Kolklata

Course Name : Circuit and Network Theory Laboratory					
Course Code :ECEN2152					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**1.5**

Course Outcomes:

1. The students will be able to apply MATLAB/OCTAVE for circuitanalysis.
2. They will derive transfer functions of electrical networks.
3. The students will analyze two port network
4. They will be able to design different filters.

List of Experiments:

1. Determination of Laplace transform and Inverse Laplace transform of different using MATLAB/OCTAVE.
2. Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB/OCTAVE in both discrete and analog form;
3. Representation of Poles and Zeros in s-plane, determination of partial fraction expansion in s-domain and cascade connection of second-order systems using MATLAB/OCTAVE
4. Find out the transfer function of an electrical Network containing RL, RC & RLC and find out pole- zero
5. Transient response of R-L and R-C network using SPICE
6. Transient response of R-L and R-C network using hardware components
7. Transient response of R-L-C series and parallel circuit using SPICE and hardware Verification
8. Verification of Network theorems (Reciprocity, Compensation theorem) using SPICE software
9. Determination of Impedance (Z), Admittance (Y) and Transmission (T) parameter of a two port network using SPICE or circuit maker.
10. Determination of Impedance (Z), Admittance (Y) and Transmission (T) parameter of a two port network using hardware.
11. Design of Butterworth Low Pass and High Pass filters: Simulation / Hardware.
12. Design of Band Pass and Band Reject filters using Butterworth Low Pass and High Pass filters: Simulation/Hardware.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name : Signals And Systems					
Course Code : ECEN2103					
Contact Hours per week	L	T	P	Total	Credit Point
	3	0	0	3	3

Course Outcomes:

1. Students should be able to apply the previous knowledge of mathematics on differential calculus.
2. Students should be able to categorize and identify the different types of signals and systems.
3. Student should be able to analyze the frequency domain characteristics of signals using Fourier series, Fourier transforms, Laplace Transform, Z- Transform.
4. Students should be able to implement and extends the concepts of transformation tools to design of communication systems and filters.
5. Students should be able to analyze random signals and its properties, hence extending the concept towards in communications systems.
6. Students should be able to evaluate the response different systems with the applications of different mathematical tools.

Module No-1: Introduction to Signal and Systems: [8 L]

Classification of Signals: Discrete and continuous signal, Periodic aperiodic, even – odd, energy and power signals, deterministic and random signals, complex exponential and sinusoidal signals, periodicity, unit impulse, unit step, transformation of independent variable of signals, time scaling, time shifting.

Properties of Systems: Linearity, Causality, time invariance and stability. Dirichlet's conditions, Distortion-less systems, Invertible systems, Frequency response of LTI system-continuous and discrete system.

Module No-2: Analysis of continuous time signals: [8 L]

Convolution in continuous time, Correlation of continuous –time signals, Continuous time Fourier Series, Fourier transformation of continuous time signals and their properties.

Laplace transformation: analysis and characterization of LTI systems with examples and properties. Computation of impulse response and transfer function using Laplace transform, Analysis of basic electrical circuits using Laplace Transform, Parseval's theorem.

Module No-3: Analysis of discrete time signals: [10L]

Convolution in discrete time, Correlation of discrete time signals, Discrete time Fourier Series, Fourier transformation of discrete time signals and their properties.

Z-transform for discrete time signals, Region of convergence, System functions, Poles and zeros of system, analysis and characterization of LTI systems with examples and properties using z- transform , Computation of impulse response and transfer function using z-transform.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module No-4: Application of Signals and Systems theory: [10 L]

4.1Sampling Theorem, Types of sampling, Aliasing, Pre-alias filter, Reconstruction of a signal from its samples, Modulation for communication, Sampling of Band-pass signals, Filtering

4.2. **Random process and noise:** Random variable, random process, ensemble, sample function, time average, ensemble average, stationary and ergodic process, correlation between two random variables. Definitions-distribution & density function, mean values &moments, function of two random variables, spectral densities, response of LTI system to random inputs, Noise sources in circuits, noise in communication circuits and systems, noise voltage.

Text Books:

1. A.V.Oppenheim, A.S.Willsky and S.H.Nawab -Signals &Systems, Pearson
2. B.P.Lathi- Signal Processing & Linear Systems- Oxford
3. P.Ramesh Babu & R.Anandanatarajan- Signals and Systems 4/e- Scitech
4. Sanjay Sharma-Signals and Systems, Kataria Publication

References:

1. J.G. Proakis & D.G. Manolakis- Digital Signal Processing Principles, Algorithms and Applications,.
2. A.Nagoor Kani- Signals and Systems- McGraw Hill
3. S.Haykin & B.V.Veen, Signals and Systems- John Wiley
4. S.Haykin,Digital Communication-John Wiley
5. Digital signal Processing by S.K. Mitra-Tata McGraw Hill

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name : Signals And Systems Laboratory					
Course Code :ECEN2153					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Outcomes:

1. The students after the course will learn to study signal synthesis using SA.
2. They will understand convolution of two signals.
3. The students will learn Fourier and Laplace transforms and applications.
4. They will be able to measure filter response.

<u>Hardware Experiments-:</u>

1. To Study Signal Synthesis via sum of harmonics using spectrum analyzer.
2. Study of sampling theorem.

<u>Software Experiments-:</u>

5. To study the generation of different type of continuous and discrete signals.
6. To study the different operation ofsignals.
7. To study convolution theorem in time and frequency domain.
8. To study the autocorrelation and crosscorrelation of signal.
9. To study the Fourier transform and Laplace transform.
10. Magnitude and phase response of the filters.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name : Analog Communication Laboratory					
Course Code :ECEN2251					
Contact Hours per week	**L**	**T**	**P**	**Tota l**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

1. The students will learn to analyze AM and FM signals using spectrum analyzer.
2. They will be able to design AM demodulator.
3. The students will be in a position to design FM demodulator.
4. They will know the procedure to measure Radio receiver parameters.

List of Experiments:

1. Measurement of modulation index varying modulating signal amplitude of an AM signal.
2. Design an AM demodulator (Envelope detector).
3. Spectral analysis of AM Signal.
4. Design of a voltage controlled oscillator (VCO).
5. Measurement of modulation index varying modulating signal amplitude of a FM signal.
6. Design a FM demodulator using PLL.
7. Spectral analysis of FM signal.
8. Study of Pre-Emphasis and De-Emphasis.
9. Measurement of selectivity, sensitivity and fidelity of a super-heterodyne receiver.
10. Experiment Beyond curriculum.

Banerjee
HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name : Digital Systems Design					
Course Code : ECEN2202 *					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

* Upto Ver 1.1, the code was ECEN 2002 modified in Ver 1.2 (Subject name remains same). The code ECEN 2202 is applicable from 2023 pass out students.

Course outcomes:

1. Make use of the concept of Boolean algebra to minimize logic expressions by the algebraic method, K-map method, and Tabular method.
2. Construct different Combinational circuits like Adder, Subtractor, Multiplexer, De-Multiplexer, Decoder, Encoder, etc.
3. Design various types of Registers and Counters Circuits using Flip-Flops (Synchronous, Asynchronous, Irregular, Cascaded, Ring, Johnson).
4. Outline the concept of different types of A/D and D/A conversion techniques.
5. Realize basic gates using RTL, DTL, TTL, ECL, and CMOS logic families.
6. Relate the concept of Flip flops to analyze different memory systems including RAM, ROM, EPROM, EEROM, etc.

Module-1[8 L]

Data and number systems; Binary, Octal, and Hexadecimal representation and their conversions;

BCD, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic. Boolean algebra, De-Morgan's theorem, Various Logic gates-their truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K- map method, Tabular method.

Module-2: [12 L]

Combinational circuits- Adder and Subtractor, BCD adder, Encoder, Decoder, Comparator, Multiplexer, De- Multiplexer and Parity Generator. [7]

Memory Systems: Concepts and basic designs of RAM, ROM, EPROM, EEROM, Programming logic devices and gate arrays. (PLAs and PLDs)[5]

Module-3: [8L]

Sequential Circuits- Basic memory element S-R, J-K, D, and T Flip Flops, Interconversions of Flip-

Flop, State table and state transition diagram, sequential circuits design methodology, various types of Registers and Counters (Synchronous, asynchronous, Irregular, ring, johnson) and their design, Lockout and its remedy.

Module-4: [8 L]

a) Different types of A/D (Flash, SAR, Counter type, Dual slope) and D/A(R-2R, weighted resistor) conversion techniques.[4 L]

HOD, ECE Department
Heritage Institute of Technology
Kolkata

b) Logic families- RTL, DTL, TTL, ECL, and CMOS, their operation and specifications.[4 L]

Total: 36 hours

Textbooks:

1. Morris Mano-Digital Logic Design, PHI
2. R.P.Jain-Modern Digital Electronics, 2/e, Mc Graw Hill
3. Virendra Kumar-Digital technology, New Age Publication
4. S.Salivahanan, S.Arivazhagan-Digital Circuit & Design, Bikas Publishing
    A. Anand kumar-Fundamental of Digital Circuits, PHI

References:

1. H.Taub & D.Shilling-Digital Integrated Electronics, Mc Graw Hill
2. Tocci, Widmer, Moss-Digital Systems, 9/e, Pearson
3. Leach & Malvino-Digital Principles &Application, 5/e, Mc Graw Hill
4. Floyed & Jain-Digital Fundamentals, Pearson

Course Name : Digital Systems Design Lab					
Course Code : ECEN2252					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

* Upto Ver 1.1, the code was ECEN 2052, modified in Ver 1.2 (Subject name remains same).
The code ECEN 2252 is applicable from 2023 pass out students.

Course Outcomes:

The students after finishing this course will be able to:

1. Design code converters.
2. Design adder and subtractor circuits.
3. Design decoders and multipexer circuits.
4. Realize counters.

List of Experiments:

1. Realization of basic gates using Universal logic gates.
2. Code conversion circuits- BCD to Excess-3 and vice-versa.
3. Design of Four-bit parity generator and comparator circuits.
4. Construction of simple arithmetic circuits-Adder, Subtractor.
5. Construction of simple Decoder & Multiplexer circuits using logic gates.
6. Realization of different combinational circuits using Multiplexers.
7. Realization of RS, JK, and D flip-flops using Universal logicgates.
8. Realization of Asynchronous Up/Down counters.
9. Realization of Synchronous Up/Down counters.
10. Design of Sequential Counter with irregular sequences.
11. Realization of Ring and Johnson's counters.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name : EM Theory And Transmission Lines					
Course Code : ECEN2203					
Contact Hours per week	L	T	P	Total	Credit Point
	3	0	0	3	3

Course Outcomes:

After going through this course, the students will be able to:

1. Apply their pre-requisite knowledge of Electrostatics and Magneto statics.
2. Comprehend Electromagnetic wave propagation in different mediums.
3. Understand different electromagnetic phenomena associated with Transmission Lines.
4. Design of Impedance Matching Networks for two wire Transmission Lines.
5. Develop the ability to analyze the radiation characteristics of antenna configurations and identify respective areas of application.
6. Understand pattern synthesis and analysis in linear antenna array.

Module I: [6]

Faraday's law & Lenz's law, Transformer and Motional Electromotive Forces, Displacement Current, JC - JD Relation, Maxwell's equations, Time Varying Potentials, Time-harmonic fields, Wave Equation, Boundary Conditions between media interface; Uniform Plane wave.

Module II: [10]

Plane Wave Propagation in Lossy Dielectric, Loss-less Dielectric, Good Conductor, Free space; Poynting Theorem, Power flow, Poynting vector, Skin Depth, Surface Resistance, Wave Polarization; Reflection and Transmission for normal and oblique incidence.

Module III: [12]

Transmission Lines; Concept of Lumped parameters and Distributed parameters. Line Parameters, Transmission line equations and solutions, Physical significance of the solutions, Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation; Condition for minimum distortion and minimum attenuation, Transmission line losses, Distortion-less Line, Reflection and Transmission coefficients; Standing Waves, VSWR, Input Impedance, Smith Chart -Applications; Load Matching Techniques / Quarter wave Matching, Bandwidth problem; Low loss RF transmission lines, line as circuit elements.

Module IV: [6]

Antenna Concepts, Antenna Characteristic; Hertzian dipole (Radiation Fields, Radiation Resistance, Radiation patterns, Directive Gain); Properties and typical applications of Half-wave dipole, Loop antenna, Yagi-Uda array, Basic Concepts of antenna array.

Text Books

1. Principles of Electromagnetics, 4th Edition, Matthew O H Sadiku, Oxford University Press.
2. Electromagnetic Field Theory & Transmission Lines, G.S.N. Raju, Pearson Education

3. Electromagnetic Waves Shevgaonkar, Tata-McGaw-Hillr –R K
4. Antenna Theory: Analysis and Design, 3rd edition, C.A. Balanis, Wiley India.

Reference Books

1. Engineering Electromagnetics, 2ed Edition - Nathan Ida, Springer India.
2. Time Harmonic Electromagnetic Fields, Roger F. Harrington, IEEE Press Series.
3. Electromagnetic Theory & Applications, A. K. Saxena, Narosa Publishing House Pvt. Ltd.
4. Engineering Electromagnetics, 7thEdition-W.H.Hayt & J.A.Buck, Tata-McGraw-Hill.
5. Electromagnetic Waves and Transmission Lines- by G.Prasad, J.Prasad and J.Reddy-Scitech.

Course Name : EM Theory and Transmission Lines Laboratory					
Course Code : ECEN2253					
Contact Hours per week	L	T	P	Total	Credit Point
	0	0	2	2	1

Course Outcomes:

1. The students will be able to plot SW pattern under different conditions.
2. They will learn generation and study of Smith Chart.
3. The students will be able to study radiation patterns of various types of antennae.
4. They will be able to undertake parametric study of antenna.

[At least THREE experiments from Module I and FOUR experiments from Module II]

Module I:

1. Plotting of Standing Wave Pattern along a transmission line when the line is open-circuited, short-circuited and terminated by a resistive load at the load end.
2. Measurement of Input Impedance of a terminated coaxial line using shift in minima technique.
3. Study of Smith chart on MATLAB/OCTAVE platform.
4. Simulation study of Smith chart - Single and double stub matching.

Module II:

5. Radiation Pattern study of dipole antenna.
6. Radiation Pattern study of a folded-dipole antenna.
7. Radiation pattern study of Helical Antenna.
8. Parametric study (Gain, Directivity, HPBW and FNBW) of three, five and seven element Yagi Uda configurations.
9. Radiation pattern study of a Pyramidal Horn Antenna.
10. Spectrum analysis of different analog signals (sine, triangular, square) using spectrum analyzer.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

<table>
<tr><td colspan="6">Course Name : Electronic Devices</td></tr>
<tr><td colspan="6">Course Code :ECEN2204</td></tr>
<tr><td rowspan="2">Contact Hours per week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
</table>

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

The students, after going through this course, will be able to:

1. Apply the previous knowledge of basic electronics engineering to appreciate the contents of this paper.
2. Understand both the particle and wave natures of electrons in Solid State Devices.
3. Identify unknown extrinsic semiconductor type using Hall Effect.
4. Describe working principles of different devices using mathematical models and energy band diagrams.
5. Justify different operations of solid state devices using relative position of Fermi energy levels across p-n junctions in devices.
6. Evaluate performance of different hetero junctions in semiconductor devices.

Module - 1: Semiconductor Physics [11L]

Recapitulation of Quantum Mechanics, Kronig Penny Model, Energy Band diagram, E-K diagram, Direct and Indirect Band-gap semiconductors, concept of effective mass, Carrier distribution in solid, concept of density of state (only expression), Fermi-Dirac distribution function, Fermi level, Intrinsic and Extrinsic semiconductors, idea of Degeneracy and Non- Degeneracy, Fermi level shift with the changes in doping and temperature. (6L) Semiconductor under equilibrium: Carrier Concentration in terms of effective Density of States, Mass-Action Law. (2L)

Semiconductor under non-equilibrium: Excess Carrier Generation and recombination with expression, concept of quasi Fermi-level.

Drift and Diffusion of carrier with expressions, Scattering Effect, Hall Effect, Piezo-electric effect (3L)

Module - 2: Diodes: **[11L]**

Homo-junctions: p-n junction physics: derivations and plots of depletion charge, electric field, potential profiles; energy band diagram, depletion width, p-n junction capacitances, Varactor diode, Derivation of p-n junction current equations, junction resistances; concepts about linearly graded and abrupt junctions. (5L)

Basic operations of different diodes: Breakdown diodes, Tunnel diode, Photo diodes (P-N, P-I-N, APD), Photoconductor, Solar cell; Basic concept about Spontaneous and Stimulated emissions, LED. (3L)

Hetero-junctions: Physics of Metal-Semiconductor & Semiconductor-Semiconductor hetero-junctions, Rectifying & Non-rectifying natures of Hetero-junctions, basic concept of potential-well & 2D electron gas. (3L)

Module - 3: Bipolar Junction Transistors (BJT): [7L]

BJT operating principle, minority carrier distributions, Different modes of operations and respective energy band diagrams, input output characteristics of BJT in CB & CE modes, base width modulation, Early effect, punch through, thermal runaway; concepts about large and small signal modeling of the device, Eber's Moll model, Hybrid-π model. Basic operation of Photo-transistor.

Module - 4: Metal Oxide Semiconductor Field Effect Transistors (MOSFET): [7L]

Physics of 2-terminal MOS structures with proper band diagrams, formation of inversion layer; MOSFET classifications: Enhancement and Depletion type MOSFETs, basic operations and V-I characteristics of both the devices; concepts of Threshold voltage and Flat-band voltage, small signal model of MOSFET, Introduction to CMOS technology. Study of MOS capacitance.

Text Books :

1. Neamen- Semiconductor Physics and Devices- TMH
2. Bhattacharya & Sharma- Solid State Electronic Devices- Oxford
3. Streetman & Banerjee- Solid State Electronic Devices- PHI

Reference Books :

1. Milman, Halkias & Jit- Electronics Devices and Circuits- TMH
2. Bell-Electronics Devices and Circuits-Oxford
3. Bogart, Bisley & Rice- Electronics Devices and Circuits- Pearson
4. Boylestad & Nashelsky- Electronics Devices and Circuit Theory- Pearson

Course Name : Circuit and Network Theory Laboratory					
Course Code :ECEN2152					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	1.5

Course Outcomes:

1. The students will be able to apply MATLAB/OCTAVE for circuitanalysis.
2. They will derive transfer functions of electrical networks.
3. The students will analyze two port network
4. They will be able to design different filters.

List of Experiments:

1. Determination of Laplace transform and Inverse Laplace transform of different using MATLAB/OCTAVE.
2. Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB/OCTAVE in both discrete and analog form;
3. Representation of Poles and Zeros in s-plane, determination of partial fraction expansion in s-domain and cascade connection of second-order systems using MATLAB/OCTAVE
4. Find out the transfer function of an electrical Network containing RL, RC & RLC and find out pole- zero
5. Transient response of R-L and R-C network using SPICE
6. Transient response of R-L and R-C network using hardware components
7. Transient response of R-L-C series and parallel circuit using SPICE and hardware Verification
8. Verification of Network theorems (Reciprocity, Compensation theorem) using SPICE software
9. Determination of Impedance (Z), Admittance (Y) and Transmission (T) parameter of a two port network using SPICE or circuit maker.
10. Determination of Impedance (Z), Admittance (Y) and Transmission (T) parameter of a two port network using hardware.
11. Design of Butterworth Low Pass and High Pass filters: Simulation / Hardware.
12. Design of Band Pass and Band Reject filters using Butterworth Low Pass and High Pass filters: Simulation/Hardware.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name : Analog Communication					
Course Code : ECEN2201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

HOD, ECE Department
Heritage Institute of Technology
Kolkata

COs:
After completing this course, the students will be able to:

1. Understand & apply the concepts of various types of signals, techniques for signal transmission and signal modulation from the knowledge gathered earlier.
2. Identify various parameters associated with Amplitude Modulation, time and frequency domain representations, side band frequencies etc and apply these knowledge to solve numerical problems.
3. Understand principles of various generation and detection techniques of Amplitude Modulation.
4. Identify and apply detailed knowledge of Angle modulation and demodulation techniques.
5. Analyze various multiplexing techniques and radio receivers.
6. Understand system noise and apply this knowledge to compare the noise performance of Analog Communication systems.

Module-1:[9L]

Introduction to Analog Communication: Introduction to basic elements of communication systems, Concept of modulation and its needs.

Continuous Wave Linear Modulation:

a) Amplitude modulation(AM-DSB/TC): Time domain representation of AM signal (expression derived using a single tone message), modulation index, frequency domain (spectral) representations, illustration of the carrier and side band components; transmission bandwidth for AM; Phasor diagram of an AM signal; Calculation of Transmitted power & sideband power & Efficiency ; concept of under, over and critical modulation of AM-DSB-TC.

b) Other Amplitude Modulations: Single side band modulation (SSB) both TC & SC ,Double side band suppressed carrier (DSBSC) modulation: time and frequency domain expressions, bandwidth and transmission power for DSB. The basic concepts of VSB, Spectra and band-width.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module -2 :[9L]

Generation & Detection of Amplitude Modulated signals:

c) Generation: Multiplier modulator, Balanced Modulator, Switching modulator, Square law Modulator, Generation of SSB: Frequency Discrimination method, Phase Discrimination method

d) Detection: Rectifier Detector, Square Law detector, Envelope detector, Synchronous detection for AM-SC signals, Effects of Frequency & Phase error in Synchronous detection.

Module-3:[9L]

Angle Modulation:

e) Frequency Modulation (FM) and Phase Modulation (PM): Time and Frequency domain representations, Spectral representation of FM and PM for a single tone message, Phasor diagram.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

f) Generation of FM & PM: Narrow and Wide-band angle modulation, Basic block diagramrepresentation of generation of FM & PM, Concept of VCO & Reactance modulator

g) Demodulation of FM: Concept of frequency discriminators and phasediscriminators, Phase LockedLoop.

h) Comparison between AM and FM.

Module - 4 :[9L]

i) Multiplexing: Frequency Division Multiplexing, Time Division Multiplexing,

j) Radio Receivers –Performance Characteristics of Radio Receivers, Basic block diagram of TRF and Superhetrodyne Receiver. Comparison between TRF and Superhetrodyne Receiver.

k) Noise in Communication System: Noise performance in Analog Communication systems: SNR calculation for DSB/TC, DSB-SC, SSB-TC, and SSBSC & FM.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Text Books:

1. B.P.Lathi -Communication Systems- BS Publications
2. Taub and Schilling , "Principles of Communication Systems", 2nd ed., Mc-Graw Hill
3. Singh & Sapre—Communication Systems: 2/e, TMH
4. Haykin, Communication Systems- PHI

References:

1. Carlson—Communication System,4/e , Mc-Graw Hill
2. Proakis & Salehi Fundamentals of Communication Systems- Pearson
3. V Chandra Sekar – Analog Communication- Oxford University Press
4. P K Ghosh- Principles of Electrical Communications- University Press
5. L.W. Couch Ii, "Digital and Analog Communication Systems", 2/e, Macmillan Publishing
6. Blake, Electronic Communication Systems- Cengage Learning

Course Name: FUNDAMENTALS OF DATA STRUCTURE & ALGORITHMS					
Course Code: INFO2101					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Outcome:

After successfully completing this course the students will be able to:

1. Develop the knowledge of basic data structures for storage and retrieval of ordered or unordered data.
2. Design linear and non-linear data structures to be used for storing, accessing and manipulating data, and be able to choose the appropriate data structure to be used for different real life applications.
3. Evaluate and compare the runtime and memory usage of algorithms with the help of mathematical background (Asymptotic Notation) of algorithm analysis.
4. Apply graph based algorithms on shortest path problems.
5. Apply efficient algorithm for solving problems like sorting, searching, insertion and deletion of data.
6. Analyze hash functions and collision resolution techniques for storing and retrieving data efficiently into a hash table.

Detailed Syllabus:

MODULE-I [8L] Linear Data Structure I

Introduction **[2L]**
Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code. Introduction to time and space complexity analysis of algorithm.

Array: **[1L]**
Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.

Linked List: **[5L]**
Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

MODULE II [10L] Linear Data Structure II
Stack : **[5L]**
Stack and its implementations (using array, using linked list), Principles of Recursion – Applications of stack, differences between recursion and iteration, tail recursion.

Queue: **[5L]**
Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list), applications. Implementation of deque- with input and output restriction.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

MODULE III [13L] Nonlinear Data structures

Trees: **[9L]**

Basic terminologies, tree representation (using array, using linked list).
Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left,right,full).
Binary search tree- operations ->creation, insertion, deletion, searching).
Height balanced binary tree – AVL tree --> insertion, deletion with examples only.
B- Trees – operations -->insertion, deletion with examples only.

Graphs: **[4L]**

Graph definitions and Basic concepts .Graph representations/storage implementations – adjacency matrix, adjacency list, Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS)

MODULE IV [12L] Searching, Sorting, Hashing:

Sorting Algorithms: **[8L]**

Bubble sort and its optimization, insertion sort, shell sort, selection sort, merge sort, quicksort, heap sort, radix sort. Complexity analysis.

Searching: **[2L]**

Sequential search, binary search, Interpolation Search

Hashing: **[2L]**

Hashing functions, collision resolution techniques (Open and closed hashing).

Books

1. Data Structures and Program Design In C, 2/E by Robert L. Kruse, Bruce P. Leung.
2. Fundamentals of Data Structures of C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
3. Data Structures in C,Aaron M. Tenenbaum.
4. Data Structures, S. Lipschutz.
5. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.
6. Data Structures using C,Reema Thareja

Siuli Roy

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name: FUNDAMENTALS OF DATA STRUCTURE & ALGORITHMS LAB					
Course Code: INFO2151					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	4	4	2

<u>Course Outcome:</u>

<u>After successfully completing this course the students will be able to:</u>

1. Design and analyze the time and space efficiency of the data structure.
2. Capable to identity the appropriate data structure for a given problem.
3. Implement the Stack ADT using both array based and linked-list based data structures.
4. Implement the Queue ADT using both array based circular queue and linked-list based implementations.
5. Implement Nonlinear Data structure operations and its applications
6. Apply Sorting and Searching algorithms on various problems and analyze run-time execution of these methods.

<u>Syllabus:</u>

1. Design and Implement List data structure using i) array ii) singly linked list.
2. Design and Implementation of basic operations on doubly linked list.
3. Design and Implementation of Linear Data Structure :
   a) Stack using i)array ii) singly linked list
   b) Queue using i)array ii) singly linked list
   c) Basic operations on Circular Queue
4. Design and Implementation of Conversion and Evaluation of expressions(Infix, Postfix) operations.
5. Implementation of Sorting Techniques.
6. Implementation of Searching Techniques.
7. Design and Implement Binary Search Tree (BST)- create, insert, delete, search elements. Traversal in a BST- inorder, preorder, postorder.
8. Design and Implement Graph Algorithms: BreadthFirstSearch Techniques, DepthFirstSearch Techniques.

<u>Books</u>

1. Brian W.Kernighan and Dennis M.Ritchie, The CProgramming Language, Prentice Hall of India.
2. E.Balaguruswamy,ProgramminginANSIC, Tata McGraw-Hill.
3. ByronGottfried,Schaum'sOutlineofProgrammingwithC,McGraw-Hill.
4. SeymourLipschutz,DataStructures,Schaum'sOutlinesSeries,TataMcGraw-Hill.
5. EllisHorowitz,SatrajSahniandSusanAnderson-Freed,FundamentalsofDataStructuresinC, W.H.Freeman and Company.
6. R.G.Dromey,HowtoSolveitbyComputer,Prentice-HallofIndia.
7. Reema Thareja, Data Structures using C, Oxford University Press.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Honours Course for 2nd Year 1st Semester

Course Name: INFORMATION THEORY & CODING					
Course Code: INFO2111					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Course Outcome:

After successfully completing this course the students will be able to:

1. Derive equations for entropy, mutual information and channel capacity for all types of channels.
2. Compare among different types of error correcting codes.
3. Evaluate the channel performance using Information theory.
4. Formulate the basic equations of linear block codes.
5. Apply convolution codes for performance analysis.
6. Design BCH code for Channel performance improvement.

Detailed Syllabus:

MODULE-I [14L]

Source Coding: Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes, Shanon Codes.

Channel Capacity and Coding: Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.

MODULE-II [15L]

Linear And Block Codes For Error Correction: Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes.

Cyclic Codes: Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes.

MODULE-III [8L]

BCH Codes:Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, Error Syndrome,Error location polynomial,examples of BCH codes.

MODULE-IV [8L]

Convolutional Codes :Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Books

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Information and Coding - N Abramson; McGraw Hill.
3. Introduction to Information Theory - M Mansurpur; McGraw Hill.
4. Information Theory - R B Ash; Prentice Hall.
5. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.
6. Introduction to Error Control Codes-Salvatore Gravano.

Course Name: FORMAL LANGUAGE & AUTOMATA THEORY					
Course Code: INFO2201					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After successfully completing this course the students will be able to:

1. Recall Knowledge of elementary discrete mathematics including the notion of set, function, relation, product, partial order, equivalence relation, graph & tree.
2. Classify, describe and discuss different types of Grammar (Chomsky's classification: Type 0. Type1, Type 2 and Type 3) and its corresponding Machines like (TM, LBA, PDA, FA).
3. Describe, Evaluate and express the different concepts in automata theory and formal languages such as formal proofs, (non-) deterministic automata, regular expressions, regular languages, context-free grammars, context-free languages, different Machines (LBA, Turing, DFA, NFA, nPDA, dPDA).
4. Apply powerful model of computation since they help computer scientists understand the limits of mechanical computation by providing a precise definition of an 'algorithm' or 'mechanical procedure'.
5. Construct different languages (type0-unresticted language, type1-context sensitive language, type2- context free language, type 3: regular language) and Turing machines
6. Develop and Evaluate different Machines corresponding different types of language like Unrestricted language: Turing Machine(TM), context sensitive language: Linear Bounded Automata, Context free language: Push Down Automata, Regular language: Finite Automata.

Detailed Syllabus:

MODULE-I [11L]

Fundamentals:

Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram (Relating of Automata concept to sequential circuit concept), Design of sequence detector, Introduction to finite state mode

Finite state machine:

Definitions, capability & state equivalent, kth- equivalent concept, Minimization of FSM, Equivalence between two FSM's , Limitations of FSM, Merger graph, Merger table, Compatibility graph, Finite memory definiteness, testing table & testing graph, Information lossless.

MODULE-II [13L]

Deterministic finite automaton and non deterministic finite automaton. Transition diagrams and Language recognizers.

Finite Automata:

NFA with Î transitions - Significance, acceptance of languages.

Conversions and Equivalence:

Equivalence between NFA with and without λ-transitions. NFA to DFA conversion. Application of finite automata, Finite Automata with output- Moore & Mealy machine.

Regular Language :

Regular sets Regular expressions, identity rules. Arden's theorem state and prove Constructing finite Automata for a given regular expressions, Regular string accepted by NFA/DFA, Pumping lemma of regular sets, Closure properties of regular sets (proofs not required).

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

MODULE-III [11L]

Grammar Formalism:

Regular grammars-right linear and left linear grammars. Equivalence between regular linear grammar and FA. Inter conversion, Context free grammar. Derivation trees, sentential forms. Right most and leftmost derivation of strings (Concept only). Context Free Grammars, Ambiguity in context free grammars. Normal forms for Context Free Grammars. Chomsky normal form and Greibatch normal form. Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (proofs omitted). Closure property of CFL, Ogden's lemma & its applications.

MODULE-IV[8L]

Push Down Automata:

Push down automata, definition. Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, interconversion (Proofs not required). Introduction to DCFL and DPDA.

Turing Machine :

Turing Machine definition, model, Design, Computable functions, Universal Turing Machine, Halting problem (proofs not required)

<u>Books:</u>

1. Introduction to Automata Theory Language and Computation, Hopcroft H.E. and Ullman J. D., Pearson education.
2. Theory of Computer Science,Automata Languages and computation, Mishra and Chandrashekaran, 2nd edition, PHI.
3. Formal Languages and Automata Theory, C.K.Nagpal, Oxford.
4. Switching & Finite Automata, ZVI Kohavi, 2nd Edn., Tata McGraw Hill.
5. Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
6. Introduction to languages and the Theory of Computation, John C Martin, TMH.
7. Elements of Theory of Computation, Lewis H.P. & Papadimitrou C.H. Pearson, PHI.
8. An Introduction to Formal Languages and Automata, Peter Linz, Jones & Bartlett Learning.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name: OBJECT ORIENTED PROGRAMMING					
Course Code: INFO2202					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

After successfully completing this course the students will be able to:

1. Recall the knowledge of procedural language and map it to paradigm of Object oriented concept.
2. Relate the real world problem with object oriented approach.
3. Describe and illustrate the features of object oriented programming.
4. Analyze any real world problem with object oriented approach and formulate a solution for the same.
5. Manage the complexity of procedural language by using the concept polymorphism, inheritance, abstraction, encapsulation.
6. Create and explain some GUI and thread based application.

Detailed Syllabus:

MODULE-I [10L]
Basics of OOP and Introduction to JAVA:
Properties of object oriented programming language, Comparison between object oriented programming language and Procedural Programming Language, Major and minor elements, Object, Class, relationships among objects. Aggregation, Association, Generalization, meta-class. Class, object, message passing, inheritance, encapsulation, polymorphism.
Basic concept of JAVA programming– advantages of java, byte-code & JVM, data types, operators, control statements & loops, array, creation of class, object, constructor, finalize and garbage collection.

MODULE-II [10L]
Class & Object proprieties:
Different types of access specifiers, method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, static variables, methods and block nested & inner classes, basic string handling concepts, concept of mutable and immutable string.
Reusability properties:
Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, abstract classes & methods, interfaces. Creation of packages, importing packages, member access for packages. Implementation of different relationships in OOPs.

MODULE-III [8L]
Exception handling and I/O:
Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes. Input Output stream structure, Wrapper class, command line arguments, basics of I/O operations – keyboard input using BufferedReader & Scanner classes. File copy programming using command line arguments.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

MODULE-IV [10L]
Multithreading and Applet & Swing Programming:
Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread communication, deadlocks for threads, suspending & resuming threads. Basics of applet programming, applet life cycle, difference between application & applet programming, parameter passing in applets. Basic of swing programming, Difference between applet and swing, AWT Event handling, message box input box, introduction to JFrame, JButton , JLabel.

<u>Books</u>

1. Object Oriented Modelling and Design,Rambaugh, James Michael, Blaha ,Prentice Hall, India.
2. Object Oriented System Development Ali Bahrami,Mc Graw Hill.
3. The complete reference-Java2,Patrick Naughton, Herbert Schildt,TMH.
4. Core Java For Beginners,R.K Das,VIKAS PUBLISHING.
5. Java How to Program,Deitel and Deitel,6th Ed. – Pearson.
6. Beginning Java 2 SDK,Ivor Horton's,Wrox.
7. Programming With Java: A Primer,E. Balagurusamy,3rd Ed.,TMH.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name: COMPUTER ORGANIZATION AND ARCHITECTURE					
Course Code: INFO2203					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

Course Outcome:

After successfully completing this course the students will be able to:

1. Describe and explain the difference between computer organization and computer architecture .
2. Design the ALU for different arithmetical and logical problems and apply the knowledge of different multiplication and division algorithm.
3. Formulate design methodology for using various types of instructions.
4. Differentiate between different Memory hierarchy(Primary, Secondary, Cache). Able to solve different kind of numericals based on memory technologies and page replacement techniques.
5. Differentiate between types of pipeline, hazards and selecting remedial techniques to handle the hazards. able to distinguish between parallel architectures. Compare performance parameters of pipelines and deduce derivations to demonstrate change in performance parameters when branching is introduced. Able to solve numericals based on pipeline concepts.
6. Comparing techniques of ILP, types of CU, types of shared memory architectures. Distinguish between different multiprocessor architectures, Data Flow architecture, RISC and CISC architecture.

Detailed Syllabus:

MODULE-I [11L]
Introduction to Computer and Computer Arithmetic:
Von Neumann and Harvard Architecture, Computer organization vs Computer Architecture, Instruction format, Addressing modes, Addition and subtraction with signed magnitude, Half adder, Full adder, Ripple carry adder, Carry Look-ahead adder, Multiplication algorithm, Division algorithm, Floating point number representation, IEEE 754 standard and ALU design.

MODULE-II [10L]
Memory Organization and I/O techniques:
Inclusion, coherence and locality properties, Memory Hierarchy, Cache memory organization, Memory replacement policies, Techniques for reducing cache misses, Virtual memory organization, Mapping and management techniques, Modes of transfer, Handshaking and DMA.

MODULE-III [10L]
Pipeline and ILP:
Quantitative techniques in computer design, Introduction to pipeline, Instruction pipeline, Arithmetic pipeline, processor pipeline, Types of Pipeline hazards and its countermeasures, Super-pipeline, Superscalar and VLIW architecture. Introduction to ILP and techniques to improve ILP, Array and Vector processor.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

MODULE-IV [11L]

Multiprocessor Architecture and Control Unit:

Taxonomy of parallel architectures, Types of Multiprocessor architectures, Multi Cache inconsistency, Centralized and Distributed shared memory architecture, Memory Consistency models, Cluster computer, Data flow architecture, RISC and CISC architecture. Introduction to Control unit, Hardwired CU and Micro programmed CU.

Books

1. Advanced Computer Architecture by Kai Hwang.
2. Computer Architecture: A Quantitative approach- Patterson and Hennessy.
3. Computer Architecture and Parallel processing- Hwang and Briggs.
4. Computer Architecture by T.K.Ghosh.
5. Computer System Architecture, PHI Mano, M.M.
6. Computer Organisation, McGraw Hill Hamacher

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name: DATABASE MANAGEMENT SYSTEMS					
Course Code: INFO2204					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

<u>Course Outcome:</u>

<u>After successfully completing this course the students will be able to:</u>

1. Understand the need of DBMS over traditional file system and acquire the knowledge on overall database description, at three levels, namely, internal, conceptual, and external levels
2. Deduce the constraints , i.e., the candidate keys, super-keys, that exists in a given real world problem and design the entity relationship diagram to graphically represent entities and their relationships to each other, typically used in computing in regard to the organization of data within databases or information systems
3. Formulate a mathematical tool using relational algebra that operates on one or more relational tables and outputs a relational table as result, and design a normalized Database based on real-world situations, maintaining all constraints and manipulate database relations using SQL and PL/SQL.
4. Prove whether the ordering of concurrent transactions result in inconsistency of the database system or not.
5. Compare the number of block access required for searching a particular record, in an un indexed data file, with respect to a data file having (primary , secondary , clustering or multilevel) index structure.
6. Create a complete Normalized Database system, maintaining all the requirement specifications for a real life problem, and creating indexed relations for efficient accessing.

<u>Detailed Syllabus:</u>

MODULE-I [7L]
Introduction and Conceptual Modeling
Database Model, Schema and architecture: **[2L]**
Concept & Overview of database and DBMS, Advantages of using DBMS approach, Database Users , Database Administrator, Database applications. Data Models and its categories, Schema, Instances, Database Languages, Three Schema architecture of DBMS, Data independence, Centralized and client server architecture for DBMS. Classification of DBMS. Introduction to big data.

Entity-Relationship Model: **[5L]**
Basic concepts, Design Issues, Cardinality, SuperKeys, Candidate keys, Entity types, Entity sets, attributes and keys. Relationship types, Relationship sets, Attributes of relationship types, Weak Entity Sets , ER diagram design issues, Extended E-R modeling: generalization, specialization, aggregation.

MODULE-II [10L]
Relational Model: Languages and query processing

Introduction to relational model: **[1L]**
Concepts of domains, attributes, tuples, relations. Transformation of ERD model to relational model.
Relational Algebra and Calculus: **[5L]**
Operators in relational algebra: select, project, rename, cartesian product, different types of join, Division,Intersect, Union, Minus. Tuple relational calculus, Domain relational calculus.
Introduction to Database languages **[4L]**
SQL: Concept of DDL, DML, DCL,TCL,DQL. Query structure, concept of subquery, group functions. View. PL/SQL basic structure, Control structure, Cursor,Triggers.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

MODULE-III [12L]

Relational Database Design

Database integrity: **[1L]**

Domain constraints, entity integrity, referential integrity constraints. Concept of null and not null constraint

Functional Dependencies: **[3L]**

Basic concept of functional dependency, Axioms, Closure, Attribute closure, Equivalent set of FD, Cover, Canonical cover.

Normalization: **[8L]**

Concept of Super keys, Candidate keys. Determining candidate keys from FD. Different anomalies in designing a Database. First, second and third normal form, Boyce-Codd Normal Form, Nomalization using multi-valued depedencies and join dependency. Dependency preservation, Lossless decomposition. Query Opyimization.

MODULE-IV [13L]

Transaction Processing, Data Storage

Transaction processing concepts **[8L]**

Transaction properties, states, serial vs. concurrent execution, Serializability, Concurrency control techniques, and Recovery Management

File Organization & Index Structures **[5L]**

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree .

Books

1. Database System Concepts ,Henry F. Korth and Silberschatz Abraham,Mc.Graw Hill.
2. Fundamentals of Database Systems,Elmasri Ramez and Navathe Shamkant, Benjamin Cummings Publishing. Company.
3. Introduction to Database Management Date C. J., Vol. I, II, III, Addison Wesley.
4. Database Management System,Ramakrishnan, McGraw-Hill
5. Transaction Processing : Concepts and Techniques Gray Jim and Reuter Address, Moragan Kauffman Publishers.
6. Advanced Database Management System Jain: CyberTech.
7. Principles of Database Systems,Ullman JD., Galgottia Publication.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

<table>
<tr><td colspan="6">Course Name: OBJECT ORIENTED PROGRAMMING LAB</td></tr>
<tr><td colspan="6">Course Code: INFO2252</td></tr>
<tr><td rowspan="2">Contact Hours per week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>3</td><td>1.5</td></tr>
</table>

Course Outcome:

After successfully completing this course the students will be able to:

1. Analyze a problem and design a solution for the problem, following an algorithmic design paradigm.
2. Implement Object Oriented Programming Features to improve the solution designs.
3. Apply Multithreading solutions of real life problems.
4. Reconstruct the solution to a problem in GUI mode.
5. Design programs in platform independent environment.

Syllabus:

Implement all problems abiding by features of object oriented programming (Abstraction, Encapsulation, Reusability, Data Hiding, Generalization, Specialization.)

Lab1:
Familiarization on object oriented approach of programming: use of class, object, reference.

Lab 2:
Use of constructor, static, final, array, date, access specifiers.

Lab 3:
Familiarization with String, StringBuffer, ArrayList and LinkedList classes

Lab 4:
Inheritance and Dynamic Method Dispatch

Lab 5 & 6:
Abstract Class, Interface and Package
Java Exception Handling.

Lab 7:
Familiarization on Java IO using Scanner, BufferedReader, PrintWriter. File handling in Java.

Lab 8:
Exploring Java multithreading concept.

Lab 9:
Java Applet, AWT Event Handling

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Lab 10:
Exploring JOptionPane
Basics of Java Swing: Different Layouts, Event Handling

Lab 11:
Basic JDBC connection and data handling.

Books

1. Object Oriented Modelling and Design,Rambaugh, James Michael, Blaha – Prentice Hall, India.
2. Object Oriented System Development ,Ali Bahrami – Mc Graw Hill.
3. The complete reference-Java2, Patrick Naughton, Herbert Schildt –TMH.
4. Core Java For Beginners R.K Das,VIKAS PUBLISHING.
5. Java How to Program, 6th Ed. Deitel and Deitel –Pearson.
6. Beginning Java 2 SDK,Ivor Horton's– Wrox.
7. Programming With Java: A Primer,E. Balagurusamy,3rd Ed. – TMH.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name: COMPUTER ORGANIZATION & ARCHITECTURE LAB					
Course Code: INFO2253					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	1.5

<u>Course Outcome:</u>

<u>After successfully completing this course the students will be able to:</u>

1. Analyze different types of logic gates and verify K-Maps and truth tables of logic gates.
2. Construct adder and subtractor circuits and defend the obtained truth tables and K-maps via TBW.
3. Design and construct Multiplexer circuits and defend the obtained truth tables and K-maps.
4. Design and construct different converters and ALU circuits and defend the obtained truth tables and K-maps via TBW.
5. Design horizontal and vertical expansion of RAM and compare their results from obtained truth tables.
6. Design seven segment display and defend the obtained truth tables.

<u>Syllabus:</u>

1. Logic gates
2. Adders: Half-Adder, Full Adder
3. Subtractors: Half Substractor, Full Substractor
4. Horizontal and vertical expansion of RAM
5. Combinational circuit designs
    a. Multiplexers: 4:1 and 8:1, 8:1 using 4:1 and 2:1
    b. Code Converters: 4-bit binary to gray, 4-bit gray to binary
    c. 7-segment display
    d. ALU

<u>Books</u>

1. The Practical Xilinx Designer Lab Book: Version 1.5, David E. Van, Den Bout, Prentice Hall.
2. Programmable Logic Fundamentals Using Xilinx ISE, Denton Dailey, Prentice Hall.
3. Programmable Logic Design Quick Start Hand Book, Karen Parnell, Nick Mehta, Xilinx Corporation.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name: DATABASE MANAGEMENT SYSTEMS LAB					
Course Code: INFO2254					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	1.5

Course Outcome:

After successfully completing this course the students will be able to:

1.Define and understand the Oracle Server architecture and also indentifying the different DDL,DML,DCL,DQL,TCL sql statement.
2.Construct and map an Entity Relationship model to relational tabular structure and maintaining all relationships and domain integrity, referential integrity, entity integrity constraints.
3. Make use of SQL commands to populate and query a database.
4. Apply and implement security and administrative aspect to a database.
5. Experiment with implementing event oriented programming using PL/SQL TRIGGER and CURSOR, and also implement user defined functions to solve real world problem.
6. Develop a normalized database system maintaining all the requirement specifications with respect to real life problem.

Syllabus:

Structured Query Language
1.Introduction to server architecture
2.Creating database objects
- Creating a Table
- Specifying Relational Data Types
- Specifying Constraints
- Creating Column Aliases
- DROP, ALTER statements
- Creating an object structure from another existing structure

3. Table and Record Handling
- INSERT statement
- DELETE, UPDATE, TRUNCATE statements
- Populating data from other tables using insert and select together

4. Retrieving Data from a Database
The SELECT statement
- Using the WHERE clause
- Using Logical Operators in the WHERE clause
- Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING
- Clause
- Using Aggregate Functions
- Combining Tables Using JOINS
- Subqueries

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

5. Database Management

Creating Views Creating

Database Users

Granting and revoking

Privileges (GRANT,

REVOKE) Granting

object privileges

Basics of Programming Language/Structured Query Language (PL/SQL)

- Conditional /Iterative Statements
- Introduction to Functions and Stored procedures
- Exception Handling
- Cursor and its application
- Triggers

Books

1. SQL, PL/SQL the Programming Language of Oracle by Ivan Bayross.
2. SQL The Complete Reference by Groff James.
3. Oracle PL/SQL Programming by Feuerstein, Steven.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name: FUNDAMENTALS OF STRENGTH OF MATERIALS					
Course Code: CIVL 2101					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Objective:

The course will assist the students to:

1. Provide the basic concepts and principles of strength of materials.
2. Give an ability to calculate stresses and deformations of objects under external loadings.
3. Provide the guidelines to calculate the member forces in truss structures.
4. Give an ability to apply the knowledge of strength of materials on engineering applications and design problems.

Module I [8L]

i. Concept of different types of applied and reaction forces; Free body concept and diagram; Concept and equilibrium of forces in two dimensions; Equations of equilibrium; Equilibrium of three concurrent forces — Lami's theorem.
ii. Centre of gravity; Centre of mass & centroid; Centroid of various shapes.
iii. Area moment of inertia: Moment of inertia of a plane figure; Polar moment of inertia of a plane figure; Parallel axes theorem.
iv. Concept of simple stress and strain; concept of salient points in the stress- strain diagram of ductile and brittle material; Modulus of elasticity. Relation between different Elastic moduli, Composite section, thermal stress.

Tapas Sadhu

Module II [14L]

i. Principal stresses, principal plane, and Mohr's circle.
ii. Hoop and meridonial stresses in thin cylindrical, conical and spherical shells.
iii. Shear force and bending moment diagrams for statically determinate beams subjected to concentrated, uniformly distributed, and linearly varying loads, relationship between loads, shear force and bending moment.

Module III [8L]

i. Bending of beams, elastic flexure formulae, Bending and shear stress, shear centre and shear flow.
ii. Analysis of determinate two dimensional trusses.
iii. Torsion in circular solid and hollow shafts.

Tapas Sadhu

Module IV [14L]

i. Slope and deflection analysis of determinate beams using Double integration method, Area-Moment theorem and Conjugate beam theory.
ii. Strain energy: Strain energy and complementary strain energy, Strain energy due to axial load, bending and shear.
iii. Columns: Fundamentals, criteria for stability in equilibrium, column buckling theory, Euler's load for columns with different end conditions – limitations and problems, eccentric load and secant formula.

Reference books

Sl. No.	Name of the book	Name of Author/Authors	Publisher
1	Elements of Strength of Material	S. P. Timoshenko and D. H. Young	EWP Pvt. Ltd
2	Engineering Mechanics of Solids	E. P. Popov	Pearson Education
3	Strength of Materials	R. Subramanian	OXFORD University Press
4	Strength of Materials	S S Bhavikatti	Vikas Publishing House Ltd
5	Strength of Material	A. Pytel & F. L. Singer	AWL Inc
6	Engineering Mechanics	J. L. Mariam	John Willey
7	Engineering Mechanics	I. H. Shames	PHI
8	Strength of Materials	S. S Rattan	McGraw Hill Education Pvt. Ltd.

Course Outcome:

After going through this course, the students will be able to:

1. Illustrate the equilibrium conditions and the concept of centre of gravity, moment of inertia of various sections.
2. Explain the elastic properties of ductile and brittle materials through stress-strain curves.
3. Determine various types of forces and stresses developed in structural elements.
4. Calculate the bending moment, shear force and deflection of beams along with developed strain energy under various loads and shear center and shear flow of prismatic sections.
5. Identify torsional moment and twist on a circular shaft.
6. Calculate the buckling load of columns using Euler's theory for different support conditions.

Tapas Sadhu

Course Name: SOIL MECHANICS - I					
Course Code: CIVL 2102					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Objective:

The course will assist the students to:

[1] Indentify different types of rock and understand their properties.
[2] Classify soil as per grain size distribution curve and understand the index properties of soil.
[3] Apply the concept of total stress, effective stress and pore water pressure for solving geotechnical problems.
[4] Apply the knowledge of permeability and seepage in solving flow problems in soil mechanics.
[5] Calculate vertical stress within a soil mass subjected to different types of loading on the ground surface and draw pressure isobar.

Sl. No.	Module	Details of Course Contents	Hours	Total
1	I	**PROPERTIES AND CLASSIFICATION OF ROCKS** **Classification and physical properties of minerals**. **Classification of rocks**: Igneous Rocks: Origin, mode of occurrence, forms & texture, classification and engineering importance, Sedimentary Rocks: Process of sedimentation, classification and engineering importance, Metamorphic Rocks: Agents and types of metamorphism, classification and engineering importance. **Weathering and Erosion of rocks**: Agents and kinds of weathering, soil formation & classification based on origin. **Engineering properties of rocks**: Porosity, permeability, compressive strength, tensile strength and abrasive resistance. **Structural Geology**: Introduction to structural elements of rocks, dip & strike, definition, description, classification of folds, faults and joints.	10	40
2	II	**PROPERTIES AND CLASSIFICATION OF SOILS** **Soil Formation and Characterization**: Introduction, Origin of Soil, Formation and Types of soil, Formative classification, Typical Indian Soil, Some Special Types of Soils, Structure and Composition, Clay Mineralogy. **Soil Phase Relationships**: Weight - Volume Relationship, Density, Unit weight, Moisture Content,	10	

Tapas Sadhu

		Specific Gravity, Relative density, Functional Relationships. **Index Properties:** Introduction, Particle Size Distribution, Mechanical Analysis - Sieve Analysis, Sedimentation Analysis – Hydrometer and Pipette Methods. Consistency of Soil – Atterberg Limits, Different Indices, Discussion on Limits and Indices. **Classification**: Classification by Structure, Particle Size Classification, Textural System, PRA System (AASHTO Classification), Unified Classification System, As per IS Code Recommendation, Field Identification of Soils, Classification by Casagrande's Plasticity Chart.		
3	III	**SOIL WATER SYSTEM** **Effective Stress and Pore Water Pressure:** Modes of Occurrence of Water in Soil – Free Water, Held Water, Structural Water, Capillary Water, Gravitational Water, Adsorbed Water, Pore Water, Pore Water Pressure, Effective Pressure, Total Pressure, Effective Pressure under Different Conditions and in Different Cases of Flow through Soils, Critical Hydraulic Gradient, Quick Sand Condition. **Permeability**: Introduction, Darcy's Law, Coefficient of Permeability, Discharge Velocity, Seepage Velocity, Factors affecting Permeability, Determination of Coefficient of Permeability by Constant and Falling Head Methods, Permeability of Stratified Soil Deposits, Field Determination of Permeability for Unconfined and Confined Aquifers. **Seepage**: Introduction, Flow net, Properties and Use of Flow net, Estimation of Seepage loss, Seepage Pressure, Two Dimensional Flow, Laplace's Equations, Flow through Earthen Dam, Piping and Heaving, Uplift pressure, Design of Filters.	10	
4	IV	**STRESS DISTRIBUTION IN SOILS** Introduction, Geostatic Stress, Boussinesq's and Westergaard's Theories regarding Vertical Stress Distribution due to Point Load, Determination of Vertical Stress due to Line and Strip Loads, Vertical Stress under Uniformly Loaded Circular Area, Isobar and Pressure Bulb, Vertical Stress Beneath a Corner of a Rectangular Area, Point Load Method, 2:1 Method, Newmark's Influence Chart, Contact Pressure.	10	

Tapas Sadhu

RECOMMENDED BOOKS:

TEXT BOOKS	
Sl. No.	Name of the books
1.	Singh, P., *Engineering and General Geology*, Katson Publishing House Delhi.
2.	Reddy, D. V., *Engineering Geology for Civil Engineers*, Oxford, IBH.
3.	Billings, M. P., *Structural Geology*, Wiley Eastern Prentice-Hall, U.S.A.
4.	Murthy, V.N.S., *Textbook of Soil Mechanics and Foundation Engineering (Geotechnical Engineering Series)*, CBS Publishers and Distributors Pvt. Ltd.
5.	Punmia, B.C. and Jain, A. K., *Soil Mechanics and Foundations*, Laxmi Publications (P) Ltd.
6.	Das, B. M., *Principles of Geotechnical Engineering*, Thomson Brooks / Cole

REFERENCE BOOKS	
Sl. No.	**Name**
1.	Tyrell, G. W., *The Principles of Petrology*, Springer.
2.	Lambe T. W. and Whitman, R.V., *Soil Mechanics*, Wiley Eastern Ltd.
3.	Holtz, R. D., Kovacs, W. D. and Sheahan, T. D., *An Introduction to Geotechnical Engineering*, Pearson Publication.
4.	Terzaghi, K., Peck, R. B. and Mesri, G., *Soil Mechanics in Engineering Practice*, A Wiley Interscience Publication (John Wiley & Sons, Inc.).
5.	Singh, A., *Soil Engineering in Theory & Practice (Vol.1, 2 & 3)*, Jain Book Agency Publishers.

Course Outcome:

After going through this course, the students will be able to:

[1] Indentify the properties of rocks and which one is suitable for construction purpose.
[2] Classify soil as per grain size distribution curve and understand the index properties of soil.
[3] Apply the concept of total stress, effective stress and pore water pressure for solving geotechnical problems.
[4] Assess the permeability of different types of soil and solve flow problems.
[5] Estimate the seepage loss, factor of safety against piping failure using flow net related to any hydraulic structure.
[6] Determine vertical stress on a horizontal plane within a soil mass subjected to different types of loading on the ground surface and also the maximum stressed zone or isobar below a loaded area.

Tapas Sadhu

Course Name: CONSTRUCTION MATERIALS AND TECHNOLOGY					
Course Code: CIVL 2103					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Objective:

The course will assist the students to:

1. To familiarize the students about the characteristics of construction materials used in civil engineering
2. To develop the skills for identification of suitable construction materials for civil engineering projects.
3. To develop the skills for identification of proper technology that deals with the construction.
4. To identify the factors to be considered in construction of buildings and develop the construction practices and techniques.

SL. No	Module	Details of Course Content	Hours	Total
1	I	**Construction Materials I** **Bricks** Introduction, Classification, Characteristics of good bricks, Ingredients of good brick earth, Harmful substance in brick earth, Testing of bricks, Fly ash brick.	2	42
		Cement Introduction, Chemical Composition of Cement, Hydration of Cement, Types of Portland Cement, Tests on Cement and Cement Paste	4	
		Aggregates Introduction, Classification, Mechanical and Physical Properties, Deleterious Substances, Alkali-Aggregate Reaction. Testing of Aggregates	3	
		Lime Introduction, Classification, Slaking and hydration	1	
		Steel Composition, properties, manufacturing, uses.	1	
		Paints, Enamels and Varnishes Composition of oil paint, characteristic of an ideal paint, enamels, distemper, water wash and colour wash, Varnish	1	

Tapas Sadhu

2	II	**Construction Materials II: Concrete** **PROPERTIES OF FRESH CONCRETE** Workability, Factors Affecting Workability, Tests on workability Segregation, Bleeding, Setting time, Mixing and Vibration of Concrete, Mixers and Vibrators, Curing Methods, Maturity. **STRENGTH OF CONCRETE** Water/Cement ratio, Gel/Space ratio, Compression Test on Cubes, Cylinders, Flexural strength of concrete **ADMIXTURES** Different types, Effects and uses. **MIX DESIGN by I.S. 10262(2009)**	**4** **4** **1** **3**	
3	III	**Construction Technology -I** **Foundations** Function of Foundations, Essential requirement of good foundation, Different types of shallow and deep Foundations. **Brick masonry** Definitions, Rules for bonding, Type of bonds, Comparison of English Bond and Flemish Bond **Walls, Doors and Windows** Load bearing wall, Partition wall, and Reinforced brick wall. Common types of doors and windows of timber and metal.	**4** **4** **2**	
4	IV	**Construction Technology -II** **Stairs** Technical Terms, Requirements of good stair, Dimension of steps, Classification, Geometric design of a dog legged stair case. **Flooring** Components of a floor, selection of flooring materials, Brick flooring, Cement concrete flooring, mosaic, marble, Terrazzo flooring, Tiled roofing. Centering and Shuttering, Plastering and Pointing: Plastering with cement mortar, Defects in plastering, pointing, White washing, colour washing, Distempering. **Roofs** Types, Pitched roofs and their sketches, **Truss**: Various types of trusses, Roof Covering materials: AC sheets GI sheet.	**2** **2** **2** **1** **1**	

Tapas Sadhu

RECOMMENDED BOOKS:

TEXT BOOKS

Sl. No.	**Name of the books**
1.	Duggal S.K. *Building Materials* , New Age International
2.	Varghese P.C. *Building Materials*, PHI Learning Pvt. Ltd-New Delhi.
3.	Punmia B.C. *Building Construction*, Laxmi Publications.

REFERENCE BOOKS

Sl. No.	**Name of the books**
1.	M. S. Shetty R. *Concrete Technology*, S. Chand.
2.	Nevile A.M. & Brooks J.J. *Concrete Technology*, Pearson Education.
3.	S.C. Rangwala *Engineering Materials*, Charotar Publishing

Course Outcome:

After going through this course, the students will be able to:

1. Impart knowledge regarding the various building and general construction products and their quality, durability and availability.
2. Impart knowledge regarding the various types of properties, uses and variety of materials used in the construction industry.
3. Study the behavior of concrete at its fresh and hardened state
4. Study about the concrete design mix.
5. Expose themselves to various quality control aspects of the civil engineering materials.
6. Learn and use the terms common in the building industry.

Tapas Sadhu

Course Name: FLUID MECHANICS					
Course Code: CIVL 2113					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Objective:

The course will assist the students to:

1. Introduce themselves to the fundamental aspects of fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
2. Learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.
3. Develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
4. Imbibe basic laws and equations used for analysis of static and dynamic fluids.
5. Inculcate the importance of fluid flow measurement and its applications in Industries.
6. Determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.

Sl. No.	Module	Details of course contents	Hours	Total
1.	I	**FLUID STATICS** Fluid pressure at a point, Variation of pressure within a static fluid, measurement of pressure, total fluid pressure on plane and curved areas, Center of pressure, buoyancy, stability of submerged and floating bodies, meta-centre.	4	44
		FUNDAMENTALS OF OPEN CHANNEL FLOW Scope and importance, characteristics of open channel flow, distinction between pipe flow and open channel flow, types of flow: Steady, Unsteady; Uniform, Non uniform, Gradually varied flow, Rapidly varied flow (definition only).	4	
		STEADY UNIFORM FLOW IN OPEN CHANNEL Characteristics, Chezy's, Manning's formulae, Hydraulically efficient Rectangular and trapezoidal sections. Design features of rigid boundary channels.	4	
2.	II	**WEIRS AND NOTCHES** Rectangular, triangular, trapezoidal and cippoletti notch, sharp crested and broad crested weirs, submerged weirs.	4	
		FLOW THROUGH PIPES Laminar and turbulent flow through pipes, Reynold's number, fluid friction in pipes, head loss due to friction. Darcy- Weisbach equation, Friction factors for commercial pipes, use of Mody's diagram, minor losses in pipes, basic concept of boundary layer, drag, lift, concept of water hammer and surge tank.	6	

3.	**III**	**SPECIFIC ENERGY / NON-UNIFORM FLOW IN OPEN CHANNEL** Definition, Diagram. Critical, Sub-critical and Supercritical flows. Establishment of critical flow, Specific force: Definition and diagram, Hydraulic Jump.	4	
		DIMENSIONAL ANALYSIS AND MODEL STUDIES Dimensions and dimensional homogeneity, Importance and use of dimensional analysis.	2	
		Buckingham Pi Theorem**:** Statement and application, Geometric, Kinematic and Dynamic similarity. Non Dimensional Numbers, Froude and Reynold model laws and applications.	4	
4.	**IV**	**MACHINERIES IN FLUID MECHANICS** Turbines, Classification and types, power and efficiency, Working Principles of Pelton, Francis and Kaplan turbines, draft tube, Cavitations in pumps and turbines.	6	
		Application of principles of similarity of hydraulic machines, specific speed of pumps and turbines, centrifugal and reciprocating pumps, performance characteristics graph for head, discharge and efficiency, hydraulic machines in parallel and series, hydraulic Ram.	6	

RECOMMENDED BOOKS:

TEXT BOOKS	
Sl. No.	Name of the book
1	Modi P.N. and Seth S.M., *Hydraulics and Fluid Mechanics including hydraulics machines*, 19th edition, Standard Book House
2	Pati S., *A textbook of Fluid mechanics and Hydraulic machines,* 1st edition, McGraw Hill Education (India) Pvt Ltd
3	Som S.K., Biswas G. and Chakraborty S., *Introduction to fluid mechanics and fluid machines,* 3rd edition, McGraw Hill Education (India) Pvt Ltd
4	Ojha C.S.P., Berndtsson R. and Chandramouli P.N., *Fluid Machines and Machinery*, 1st edition, Oxford University Press

Tapas Sadhu

REFERENCE BOOKS	
Sl. No.	Name of the book
1	Cengel Y. A. and Cimbala J. M., *Fluid Mechanics: Fundamentals and Applications*, 2^{nd} edition, Tata McGraw Hill Education Private Limited
2	Pritchard P.J. and Leylegian J.C., *Fox and McDonald's Introduction to Fluid Mechanics*, 8^{th} edition, John Wiley & Sons
3	Massey B.S. and Ward-Smith John., *Mechanics of Fluids*, 9th edition, Taylor & Francis.
4	Bansal R.K., *A textbook of Fluid Mechanics and Hydraulic Machines*, 9^{th} edition, Laxmi Publications (P) Ltd

Course Outcome:

After going through this course, the students will be able to:

1. Understand basic fluid properties (density, viscosity, bulk modulus), flow forces (pressure, shear stress, surface tension) and flow regimes (laminar/turbulent, compressible/ incompressible, steady/unsteady).
2. Use and know limitations of steady and unsteady Bernoulli equation along and normal to a streamline.
3. Explain the conservation of mass and momentum through differential analysis in simple geometries.
4. Study scope, importance, characteristics and various types of flows in an open channel.
5. Understand the techniques of dimensional analysis, similitude and modeling and introduce the important non-dimensional groups in fluid mechanics.
6. Know the concepts to internal and external flows and introduce the boundary layer concept, lift and drag, flow separation, and drag reduction fundamentals.

Tapas Sadhu

Course Name: STRUCTURAL ANALYSIS -I					
Course Code: CIVL 2201					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Objective:

The course will assist the students to:

1. Introduce themselves to concept of global structural stability, theory of structural analysis, and methods in structural analysis.
2. Develop an idea to model a structure with proper loads and support conditions.
3. Build an ability to idealize and analyze statically determinate and indeterminate structures.
4. Provide knowledge among on moving loads and procedure to calculate the influence line diagram of several functions for beams and truss.

Module I [16L]

BASICS OF STRUCTURAL ANALYSIS

(i) Concept of static and kinematic indeterminacy, Determination of degree of indeterminacy for different types of structures.

(ii) Theorem of minimum potential energy, law of conservation of energy, principle of virtual work, the first theorem of Castigilano, Betti's law, Clark Maxwell's theorem of reciprocal deflection.

ANALYSIS OF DETERMINATE STRUCTURES

Portal Frames, Three hinged arches, Cables.

DEFLECTION OF DETERMINATE STRUCTURES

Energy methods. Unit Load method for beams, Deflection of trusses and Simple Portal Frames.

Module II [6L]

INFLUENCE LINE DIAGRAM

Statically determinate beams and trusses under series of concentrated and uniformly distributed rolling loads, criteria for maximum and absolute maximum moments and shear.

Module III [16 L]

THEOREM OF THREE MOMENTS

Introduction to statically indeterminate structures, advantages of indeterminate structures over determinate structures, solved simple numerical problems on computation of static indeterminacy, Clapeyron's theorem of three moments, derivation of three moment equation, solved numerical problems of continuous beams based on different support conditions and support settlement.

Tapas Sadhu

STRAIN ENERGY

Castigliano's 2nd Theorem; solved numerical problems.

ANALYSIS OF STATICALLY INDETERMINATE BEAMS BY FORCE METHOD

Basic introduction to force method of analysis, analysis of statically indeterminate beams by force method, Solved examples, Theorem of Least work, numerical problems on theorem of least work.

TWO HINGED ARCHES

Analysis of two hinged arch, solved problems on two hinged arch.

Module IV [4L]

INFLUENCE LINE DIAGRAM OF INDETERMINATE STRUCTURES

Influence lines for statically indeterminate beams, Muller- Breslau Principle, ILD for continuous beams, Problems on ILD for continuous beam, trusses etc.

Text & References:

Sl. No.	Name	Author	Publishers
1.	Basic Structural Analysis	C.S.Reddy	Tata Mc Graw Hill
2.	Statically Indeterminate Structures	C.K.Wang	Mc Graw Hill
3.	Structural Analysis-A unified Classical and Matrix Approach.	A. Ghali and A.M.Neville	E & FN SPON
4.	Theory of Structures	Timoshenko and Wang	Tata Mc Graw Hill
5.	Engineering Mechanics of Solids	E.P.Popov	Pearson Education

Course Outcomes

After going through this course, the students will be able to:

1. Distinguish between stable and unstable and statically determinate and indeterminate structures.
2. Apply equations of equilibrium to structures and compute the reactions.
3. Calculate the internal forces in cable and arch type structures
4. Evaluate and draw the influence lines for reactions, shears and bending moments in beams due to moving loads.
5. Use approximate methods for analysis of statically indeterminate structures.
6. Calculate the deflections of truss structures and beams.

Tapas Sadhu

Course Name: SOIL MECHANICS - II					
Course Code: CIVL 2202					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Objective:

The course will assist the students to:

1. Gain an in-depth knowledge of the shear strength characteristics of soils.
2. Assess the consolidation and compaction properties of soils.
3. Determine the lateral earth pressure on rigid retaining wall and design it accordingly.
4. Investigate the stability of soil slopes under different conditions.

Sl. No.	Module	Details of Course Content	Hours	Total
1.	I	**SHEAR STRENGTH** Introduction, Basic Concept of Shear Resistance and Shear Strength of Soil, Mohr Circle of Stress, Sign Conventions, Mohr - Coulomb Theory, Relationship between Principal Stresses for both Cohesive and Cohesionless Soils, Stress Controlled and Strain Controlled Tests, Laboratory Determination of Soil Shear Parameters - Direct Shear Test, Unconfined Compression Test, Vane Shear Test, Triaxial Test as per Relevant IS Codes, Classification of Shear Tests Based on Drainage Conditions, Stress - Strain Relationship of Clays and Sands, Concept of Critical Void Ratio. Skempton's Pore Pressure Parameters, Introduction to Stress path.	10	40
2.	II	**CONSOLIDATION & COMPACTION** **Consolidation**: Introduction, Terzaghi's theory of one dimensional consolidation, Compressibility characteristics of soils, Compression index, Coefficients of Compressibility and Volume Change, Coefficient of consolidation, Degree and Rate of Consolidation, Time factor, Settlement computation, Laboratory One Dimensional Consolidation Test as per IS Code, Determination of Consolidation Parameters. **Compaction:** Introduction, Standard and Modified Proctor Compaction tests, Field Compaction methods, Factors affecting compaction, Factors affecting Compaction Characteristics of Soil.	10	
3.	III	**EARTH PRESSURE & STABILITY OF**	10	

Tapas Sadhu

		CONCRETE RETAINING WALLS **Lateral Earth Pressure**: Introduction, Plastic equilibrium of soil, Earth Pressure at Rest, Active and Passive Earth Pressures, Rankine's and Coulomb's Earth Pressure Theories, Determination of Active and Passive Earth Pressures under different conditions, Analytical and Graphical methods for Determination of Earth pressure against various Earth Retaining Structures. **Stability of Concrete Retaining Walls:** Stability checks for Cantilever retaining wall against Overturning, Sliding and Bearing Capacity.		
4.	IV	**STABILITY OF SLOPES** Introduction, Types of failure, Different types of Factor of safety, Analysis of infinite and finite slopes, Stability of Clay Slopes under Undrained Condition, Friction circle method, Taylor's stability number, Ordinary or Swedish or Fellenius method of slices, Bishop's simplified method of stability analysis.	10	

RECOMMENDED BOOKS:-

TEXT BOOKS	
Sl. No.	**Name**
1.	Murthy, V.N.S., *Textbook of Soil Mechanics and Foundation Engineering* (Geotechnical Engineering Series), CBS Publishers and Distributors Pvt. Ltd.
2.	Punmia, B.C. and Jain, A.K., *Soil Mechanics and Foundations*. Laxmi Publications (P) Ltd.
3.	Das, B.M., *Principles of Geotechnical Engineering*, Thomson Brooks / Cole.
4.	Ranjan, G. and Rao, A.S.R., *Basic and Applied Soil Mechanics*, New Age International Pvt. Ltd, Publishers.

REFERENCE BOOKS	
Sl. No.	**Name**
1.	Lambe, T. W. and Whitman, R.V., *Soil Mechanics*, Wiley Eastern Ltd.
2.	Holtz, R. D., Kovacs, W. D. and Sheahan, T. D., *An Introduction to Geotechnical Engineering*, Pearson Publication.
3.	Terzaghi, K., Peck, R. B. and Mesri, G., *Soil Mechanics in Engineering Practice*, A Wiley Interscience Publication (John Wiley & Sons, Inc.).
4.	Craig, R. F., *Craig's Soil Mechanics*, Spon Press (Taylor and Francis Group)

Tapas Sadhu

Course Outcome:

After going through this course, the students will be able to:

1. Apply the concept of shear strength to analyze different geotechnical problems and determine the shear strength parameters from lab and field tests.
2. Assess the compaction characteristics of soil for solving geotechnical problems.
3. Estimate the consolidation settlement using relevant parameters for a soil.
4. Calculate earth pressure on rigid retaining walls on the basis of classical earth pressure theories.
5. Analyze and design rigid retaining walls (cantilever types) from geotechnical engineering consideration.
6. Compute safety of dams and embankments on the basis of various methods of slope stability analysis.

Tapas Sadhu

Course Name: SURVEYING					
Course Code: CIVL 2203					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Objective:

The course will assist the students to:

1. Provide the knowledge of the importance of surveying in the field of civil engineering
2. Study the basics of linear/angular measurement methods like chain surveying, compass surveying, etc.
3. Develop the basic knowledge levelling and theodolite survey in elevation and angular measurements
4. Build an idea about the advanced surveying instruments used in present days.

Module I [8L]

BASICS OF SURVEYING

Introduction to Surveying
Definition, principles of surveying, types of scales (numerical problems), basic concepts of plans and maps.
Chain and compass Surveying
Basic introduction to different types of chains and accessories, errors in chain surveying, Basic concept and terminologies related to compass survey, local attraction and its elimination, open and closed traverse.
Plane Table Surveying
Principle, equipment and methods, two and three point problems.

Module II [12L]

METHODS OF MEASUREMENT

Levelling and Contouring
Definitions and terminology, types and methods of levelling, use of Dumpy level, Auto level and supporting accessories, different terms used in contouring, characteristics of contour and contour interval.
Theodolite Surveying and Tacheometry
Components of Theodolite, adjustments, measurement of vertical and horizontal angels, concepts of trigonometric levelling, definitions and principles of tacheometry and stadia system, fixed hair stadia method, calculation of horizontal and vertical distance using tacheometer.

Tapas Sadhu

Module III [12L]

COMPUTATION PROCEDURE AND SETTING OUT WORKS

Computation of Area and Volume

Computation of area using trapezoidal rule and Simpson's 1/3rd rule. Computation of volume of different cross sections.

Setting out of Horizontal Curves

Elements of simple circular curves and methods of setting out simple circular curve by linear and angular methods. Requirements, types and elements of transition curve.

Setting Out Of Vertical Curves

Introduction to vertical curves and its types.

Module IV [8L]

INTRODUCTION TO HIGHER SURVEYING

Measurement Procedure Using Advanced Instruments

Total Station and its different parts, practical application of Total Station.

Triangulation

Concepts of triangulation and triangulation systems in brief.

Hydrographic Survey

Shoreline survey, soundings, locating soundings and reduction of soundings, basic concept of Mean sea level, bathymetry.

Aerial Photogrammetry

Terminology, equipments and photo-theodolite

Reference books

Sl. No.	Name of the Books
1.	Duggal S. K. *Surveying (Vol-1 and 2)*. 4th edition, McGraw Hill Education (India) Pvt Ltd.
2.	Roy S.K. *Fundamentals of Surveying*. 2nd edition, PHI Learning Pvt. Ltd-New Delhi.
3.	Punmia B.C., Jain A.K. and Jain A.K. *Surveying (Vol-1 and 2)*. 15th edition, Laxmi Publications (P) Ltd.
4.	Bannister A., Raymond S. and Baker R. *Surveying*. 1st edition, Pearson India.
5.	Subramanian R. *Surveying and Levelling*. 2nd editon, Oxford university Press.

Tapas Sadhu

Course Outcome:

After going through this course, the students will be able to:

1. Study the basics of linear/angular measurement methods like chain surveying, compass surveying.
2. Understand the concepts of leveling and contouring.
3. Demonstrate the method of theodolite survey in terms of elevation and angular measurements, along with tacheometry.
4. Calculate the area and volume of any given land using different methods and rules.
5. Understand the method of setting out procedure of horizontal and vertical curves.
6. Explain various methods of higher surveying, such as triangulation, hydrographic survey, areal photogramatry and demonstrate the basic functions of advanced instrument like Total station.

Tapas Sadhu

Course Name: HIGHWAY AND TRAFFIC ENGINEERING					
Course Code: CIVL 2204					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Objectives:

The course will assist the students to:

1. Provide the knowledge of Highway Network Planning, Highway alignment and Highway Geometric Design.
2. Study different pavement materials and design different types of pavements.
3. Building and idea about Highway Construction including the drainage and its maintenance and safety.
4. Develop and idea of Traffic engineering, Traffic Signal Design and Design of at grade Intersections:
5. Analyse Parking and Accident in Transport System.

Module I [12L]

Highway Network Planning:
Different modes of transportation, Role & Development of highway transportation, Classification, Network patterns, Planning surveys, Evaluation by saturation system, Introduction to highway economics.
Highway Alignment:
Factors controlling alignments, Principles of highway alignment, engineering surveys for highway alignment and location.
Highway Geometric Design:
Importance of geometric design, design controls, pavement cross-sectional elements, PIEV theory, Sight distance, Design of horizontal alignments, Design of vertical alignments, Geometric Design of Hill Roads.

Module II [12L]

Pavement Materials:
Types and component parts of pavement and their functions, highway and airport pavement materials, basic soil & aggregate properties relevant to pavement application, basic properties of bitumen and tar, Modified Bitumen (PMB, CRMB) tests on pavement materials, Use of geo-synthetics.
Design of Pavements:
Design factors, classification of axle types, contact pressure, EWLF & ESAL concept, Traffic analysis: vehicle damage factor.
Flexible Pavement Design:
Design of flexible pavements (GI method, CBR method, Triaxial method -only introduction), IRC method of design.
Rigid Pavement Design:
Design considerations, Westergaard's theory and assumptions, Design of dowel and tie bars, Joints in Rigid Pavements, IRC method of design.

Tapas Sadhu

Module III [8L]

Highway Construction:
Construction of earth roads, gravel roads, WBM roads, Cement Concrete Pavements, Bituminous pavements.
Highway Maintenance:
Pavement failures, causes of failure, routine and periodic maintenance of highways.
Highway Drainage:
Importance of highway drainage, surface and sub-surface drainage, drainage of slopes and erosion control, road construction in water logged areas.
Highway Safety:
Introduction to highway safety, accident characteristics and factors, accident recording and analysis, road safety audit, safety education, traffic law enforcement, elements of highway safety management system, road safety management system.

Module IV [10L]

Traffic Engineering:
Introduction, road users and vehicle characteristics, microscopic and macroscopic flow characteristics, time headways, interrupted and un- interrupted traffic, speed and travel time variation, travel time and delay studies, flow and density measurement techniques, highway capacity and level of service, level of service estimation, traffic signs.
Traffic Signal Design and Design of at grade Intersections:
Signal phasing, cycle length, fixed and vehicle actuated signal, Webster method, IRC method, signal co-ordination and problems on signal design, types of intersections, rotary and round-about, design aspects.
Parking and Accident Analysis:
Parking inventory study, on street and off street parking facilities, introduction to Intelligent Transport System, accident characteristics, accident recording and analysis.

RECOMMENDED BOOKS:

TEXT & REFERENCE BOOKS	
Sl. No.	Name of the books
1.	High Way Engineering, Khanna & Justo, Nemchand& Brothers, Roorkee
2.	Principles of Transportation Engineering, P. Chakraborty& A. Das - PHI
3.	Transportation Engineering- C.J Khisty& B.K Lall., PHI
4.	Kadiyali L.R. Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, India, 1997
CODES FOR REFERENCE	
Sl. No.	Name of the Codes
1.	I.S Specifications on Concrete , Aggregate & Bitumen Bureau of Indian Standard
2.	Relevant latest IRC Codes (IRC-37 – 2001, IRC-37 – 2012, IRC 58 – 2011, IRC 73 - 1980, IRC 86 - - 1983, IRC 106 – 1990, IRC 64 – 1990, IRC 15- 2002 - Indian Road Congress

Course Outcome:

After going through this course, the students will be able to:

1. Plan highway networks and Design highway geometrics.
2. Characterize the properties of soil, aggregate, bitumen, and bituminous mixes.
3. Analyze and design rigid and flexible pavement (IRC Method).
4. Understand the principles of construction, maintenance and safety of highways.
5. Conduct traffic studies, analyze traffic data and design intersections.
6. Design traffic signal and analyze parking & accidents.

Tapas Sadhu

Subject Name: Particle and Fluid Particle Processing					
Paper Code: CHEN 2101					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

The objective of the course is to provide an elaborated concept of different unit operations that are required in an industry. After completion of the course students will be able to:

1. Calculate average particle diameters for a mixture of solid particles and select different screens according to specifications.
2. Select the type of crusher/grinder for a particular comminution operation and calculate the energy consumption.
3. Calculate drag force and terminal settling velocity for single particles in different mediums.
4. Select the type of classifier required for a given operation and given a particular thickening operation, design the thickener required.
5. Calculate power consumption for an agitation operation and scale up the agitator as per the problem given.

Module I [10L]

Characterization of particulate solids:

particle size, shape and particle size distribution; concepts of mass-mean diameter, volume- surface-mean diameter, arithmetic-mean diameter and volume- mean diameter, specific surface area of a mixture of solid particles, measurement of specific surface area of a mixture ofparticles.

Screen analysis:

concept of mesh number, types of standard screens, differential and cumulative analysis, concept of cut diameter and screen efficiency; industrial screening equipment eg. stationary screens, vibratory screens, grizzlies and trammels.

Handling and storage of solids:

Operation and performance criteria of screw, belt, pipe, apron and flight conveyors, bucket elevators. Operation of pneumatic and hydraulic conveyors. Storage of solids in bins, silos and hoppers.

Module II [10L]

Comminution (size reduction) of solids:

Different forces for comminution, laws of comminution - Rittinger's law, Kick's law, Bond's law and their validity limits, crushing efficiency and power consumption.
Primary crushing equipment: Blake jaw crusher, gyratory crusher, Taggart's law.

Secondary crushers:

Smooth and toothed roll crushers, concepts of nipping and angle of nip.

Grinders:

Operation of ball mill, critical speed of ball mil, operation of rod mill and hammer mill, applicability of these mills for different sizes of feed, vertical roller mill and attrition mill, concepts of dry and wet grinding.

Ultrafine grinders:

Colloid mill and fluid-energy mill, Close-circuit and Open-circuit size reduction.

Size enlargement:

Nucleation and growth of particles, Extrusion of solids.

Module III [10L]

Flow of particles in fluids:

Concepts of drag, boundary layer separation, skin and form drag, drag correlations.

Gravitational settling of particles:

Concepts of terminal settling velocity, Stokes's law and Newton's law regimes of settling, free and hindered settling, Richardson-Zaki equation, use of gravitational settling for solid-fluid separation, settling tank and its design principles, spitzkasten, elutriator and rake classifier, clarification and thickening, operation of Lamelar clarifiers, Hirate thickeners, design of continuous thickener using Kynch theory.

Flow through packed bed:

Ergun and Kozeny Carman equation, Darcy's law and permeability, Blaine's apparatus.

Agitation and Mixing:

Agitation equipment, different types of agitators, flow patterns in agitation, calculation of power consumption in agitated vessels, scale up of agitated vessels using concepts of geometric, kinematic and dynamic similarity, Mixing effectiveness and mixing index, solid-solid mixing equipment.

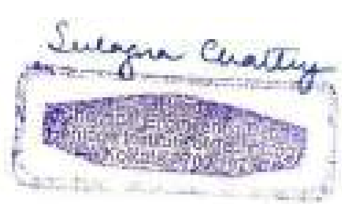
Froth flotation:

Theory, operation, flotation agents.

Module IV [10L]

Solid-liquid filtration:

Cake and clarifying filters, constant pressure and constant rate filtration, compressible and incompressible filter cakes, pressure drop through filter cake; Operation of plate and frame filter press, cake washing and filtration cycle; continuous filtration, operation of a rotary drum vacuum filter, filter aids and filter media; Centrifugal filtration.



Solid-gas filtration:

Bag filters and electrostatic filters - design principles.

Centrifugal separation:

Design and operation of cyclone separators and hydrocyclones.

Introduction to nanoparticles:

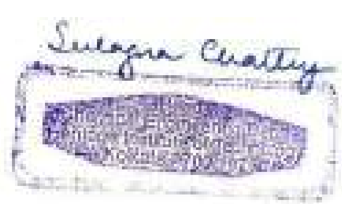
Properties, characterization, synthesis methods and applications.

Text Books:

1. McCabe W.L., Smith J.C. & Harriot P. Unit Operations of Chemical Engineering, McGraw-Hill, 7th edition, 2017.
2. Harker J.H., Backhurst J.R. & Richardson J.F. Coulson and Richardson's Chemical Engineering (Volume 2), Butterworth-Heinemann, 5th edition, 2002.

Books of reference:

1. Kulkarni A.P. & Hiremath R.S., Mechanical Operations – Unit Operations of Chemical Engineering (Volume 1), Everest Publishing House.
2. Gavhane K.A. Unit Operations-I, Fluid Flow & Mechanical Operation, Nirali Prakashan, 2019.



Subject Name: Basics of Material and Energy Balance					
Paper Code: CHEN 2103					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

The objective of the course will to be served as a basis for all further chemical engineering courses that are part of the curriculum. After completion of the course students will be able to:

1. Generate ability to handle elementary flow-sheeting given a specific process.
2. Identify skills to develop equations for energy and mass balance given a specific process.
3. Analyze any physical phenomena to obtain a functional relation between dimensionless numbers associated with the process.
4. Identify recycle, bypass and purge points in a chemical process and perform calculations with them.
5. Describe equations of state and properties of gases and liquids, including phase transition.

Module I [10L]

Introductory concepts of units, physical quantities in chemical engineering, dimensionless numbers, dimensionless groups, “basis” of calculations.

Material Balance:

Introduction, solving material balance problems without chemical reaction for industrially relevant unit operations like Evaporation, Drying, Distillation, Crystallization, Absorption, Extraction.

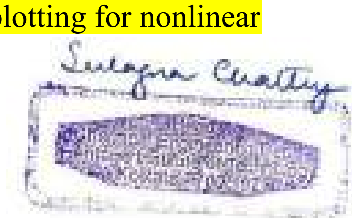
Module II [10L]

Material Balance:

With chemical reaction, Concept of stoichiometry and mole balance, examples, including combustion, Material Balances with recycle, bypass and purge – examples.

Module III [10L]

Gases, Vapours and Liquids:
Equations of state, Vapour pressure, Clausius-Clapeyron equation, Cox chart, Duhring’s plot, Raoult’s law.
Humidity and Saturation, humid heat, humid volume, dew point, humidity chart and its use.
Linear regression analysis of linear and nonlinear data, log and semilog plotting for nonlinear



data.

Module IV [10L]

Energy balance:

Open and closed system, heat capacity, calculation of enthalpy changes, adiabatic and isothermal process, non-adiabatic and non-isothermal process.

Energy balances with chemical reaction:

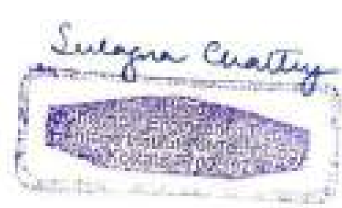
Heat of reaction, Heat of combustion, calorific value of fuel, adiabatic flame temperature.

Text Books:

1. Felder R. M. & Rousseau R. W. Elementary Principles of Chemical Processes, John Wiley & Sons, 3rd edition, 2000.
2. Himmelblau D. M. & Riggs J. B. Basic Principles and Calculations in Chemical Engineering, Pearson India Education Services, 8th edition, 2015.

Books of reference:

1. Bhatt B. I. & Vora S.M. Stoichiometry, Tata McGraw Hill Publishing Company Ltd, 4thedition, 2004.
2. Hougen O. A., Watson K. M. & Ragatz R. A. Chemical Process Principles, Part-I Material & Energy Balances, , CBS Publishers & Distributors, 2nd edition,2004.
3. Venkataramani V., Anantharaman N., Begum K.M. & Sheriffa M. Process Calculations, Prentice Hall of India, 2nd Edition,2011.
4. Sikdar D. C. Chemical Process Calculations, Prentice Hall of India, 2013.
5. Narayanan K.V. & Lakshmikutty B. Stoichiometry and Process Calculations, PHI, 2010.



Subject Name: Thermodynamics – I					
Paper Code: CHEN 2104					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

The objective of this course is to elaborate principles and application of first and second law of thermodynamics, and phase equilibrium. After completion of the course students will be able to:

1. Apply mass and energy balances to closed and open systems.
2. Evaluate the properties of non-ideal gases and quantify the deviation from ideal behavior of a real gas at any given state.
3. Solve problems involving liquefaction, refrigeration and different power cycles.
4. Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.
5. Calculate thermodynamic efficiency of a process.

Module I [10L]

Basic concept of thermodynamics:

Definition and classification of thermodynamic systems, Temperature, Pressure, Work, Energy, Heat.

Energy conservation & first law of thermodynamics; State functions; Thermodynamic Properties; Equilibrium; Phase Rule; Reversible and Irreversible process.

Energy balance for open & closed system:

Energy relation for steady flow process; Application of Steady Flow Energy Equation (SFEE) in Turbine, Compressor, Pump, Heat Exchangers, Condenser, Boilers; Isenthalpic process and Joule-Thompson Coefficient.

Module II [10L]

Thermodynamic properties of pure substance,

P-V-T behavior of pure substance:

Diagram and P-V diagram, Critical Properties (Pc, Tc & Vc) of pure substance.

Equation of State:

Ideal gas equation of state; Virial equation of state; Virial equation of state at low to moderate pressure;

Cubic equation of state:

Two parameter cubic equation of state (Van-der-waals equation of state, Redlich-Kwong equation of state), Compressibility factor; Cubic equation in reduced form; Laws of corresponding state; Compressibility factor chart; Definition of Acentric factor and its application.

Module III [10L]

Limitations of first law of thermodynamics; Statements of the second law; Concept of Heat engines and Heat pump; Carnot Cycle; Carnot's theorem; Concept of Entropy; Calculation of entropy change; Mathematical statement of the second law; Entropy balance for open systems; Calculation of ideal work, Lost work; Clausius inequality. Thermodynamic energy properties; Fundamental property relation; Maxwell relation.

Heat effects:

latent heat, sensible heat, standard heats of formation, reaction and combustion; Hess's law of constant heat summation; Effect of temperature on heat of reaction.

Module IV [10L]

Temperature-Entropy diagram; Mollier diagram; Steam table.
Ideal Power cycle; Ideal Rankine cycle; Practical Rankine cycle; Reheat cycle; Internal combustion engine: Otto cycle; Diesel cycle.
Ideal Refrigeration cycle; Vapour Compression cycle; Absorption refrigeration cycle; Thermodynamic criteria of selecting refrigerant.

Gas Liquefaction process:

Linde and Claude liquefaction process.

Text Book:

1. Smith J.M., Van Ness H.C. & Abbott M.M., Introduction to Chemical Engineering Thermodynamics, McGraw-Hill International Edition, 7th edition, 2005.

Books of reference:

1. Nag P.K., Engineering Thermodynamics, McGraw-Hill Education (India) Private Limited, 5th edition, 2013.
2. Rao Y.V.C., Chemical Engineering Thermodynamics, University Press (India) Private limited, 1st edition, 2004.

Subject Name: Fluid Mechanics (ChE) Laboratory					
Paper Code: CHEN 2151					
Contact Hours	**L**	**T**	**P**	**Total**	**Credit Points**
Per Week	**0**	**0**	**3**	**3**	**1.5**

Course Outcomes:

The objective of this course is to impart working knowledge and develop skills of the students in fluid mechanics through bridging between the theoretical concepts and working practices for attaining the competency in practical applications or for working in the industry and conducting research & development activities. After completion of the course students will be able to:

1. Predict the energy losses, economic factors and maintenance aspects in the design, installation and operations of fluid flow systems for efficient transportation of mass & energy by studying the flow characteristics namely, turbulent, laminar and transition flow of different fluids.
2. Identify the requirements of various types of devices for quantitative measurement of fluid flow in open channel (rivers,/dams etc) and in closed channel(pipe flow etc) efficiently and economically.
3. Analyze the pump characteristics relating to best efficiency of the pump, power consumption, head developed by the pump for a given flowrate.
4. Design and install pumping system to demonstrate occurrence of cavitation in the system and also to take a practical measure to avoid cavitation during fluid flow and ultimately develop skills and expertise in designing the most efficient fluid transportation system including pump & the piping.
5. Construct and design packed bed and fluidized bed chemical reactors for various types of chemical processes and unit operations with a given pressure drop and various flow rates of the fluid or vice-versa.
6. Describe the concept of packed bed or fluidized bed operations practically for physical processes such as coating granular metal surfaces with various other desirable materials by normal fluidisation technique and separation of oil from water by reverse fluidisation techniqueetc.

Experiments to be performed:

1. Determination of coefficient of discharge at various Reynolds number during fully developed fluid flow through orificemeter.

2. Determination of coefficient of discharge at various Reynolds number during fully developed fluid flow through venturimeter.
3. Determination of loss coefficient of pitot tube and construction of fully developed velocity profile through pipe in laminar and turbulent flow regime.
4. Measurement of open channel flow and determination of coefficient of discharge V-notch and rectangular notch.
5. Determination of pressure drop for flow through packed bed and verification of Ergun equation.
6. Determination of characteristic curve of a centrifugal pump.
7. Experiments on Reynolds apparatus for determination of flow regime and construction of fanning's friction factor vs Reynolds number plot.
8. Determination of pressure drop and bed height profile with varying modified Reynolds number during flow through a fluidized bed & determination of incipient fluidization.
9. Calibration of rotameter.
10. Assembling of pipe line and fitting according to a given layout.

Text Books:

1. P Pritchard P.J. Fox and McDonald's Introduction to Fluid Mechanics, John Wiley & Sons Inc., 8th edition,2011.
2. McCabe W.L., Smith J.C. & Harriot P. Unit Operations of Chemical Engineering, McGraw-Hill, 7th edition, 2017.
3. Harker J.H., Backhurst J.R. & Richardson J.F. Coulson and Richardson's Chemical Engineering (Volume 2), Butterworth-Heinemann, 5th edition, 2002.

Books of reference:

1. Jain A.K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, 1998.
2. Bird R.B., Stewart W.E. & Lightfoot E.N. Transport Phenomena, John Wiley & Sons, 2nd Edition, 2010.

Subject Name: Particle & Fluid-Particle Processing Laboratory					
Paper Code: CHEN 2152					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course Outcomes:

The objective of this course is to provide a hands-on idea on the mechanical devices that are essential in handling the material and it's processing in different chemical engineering related downstream applications. After completion of this course students will be able to:

1. Identify mechanical instruments required for particles processing before downstream applications.
2. Describe the working principle of the mechanical instruments required for particles processing.
3. Solve the experimental problems related to particles' processing applications.
4. Generate real life data from the experiments.
5. Analyze the outcome of the experiment on the basis of theoretical knowledge they had acquired.
6. Conclude on the troubleshooting required after analyzing the experimental outcomes.

Experiments to be performed:

1. Sieve Analysis: To analyze a given powder for its particle size distribution. / Cumulative and Differential methods of particle size distributions.
2. Overall Screen Effectiveness: To find out screen efficiency through a suitable material balance with respect to a single screen.
3. Jaw Crusher: To find out the reduction ratio and capacity and to verify Rittinger's law.4. Ball Mill: To determine the reduction ratio, capacity and the critical speed of the ball mill.
5. Rod Mill: To determine the reduction ratio and capacity and compare the reduction ratio for the same feed sample to that in a ball mill.
6. Hammer Mill: To find out the reduction ratio and capacity.
7. Batch sedimentation: To determine the settling and sedimentation characteristics of given

slurry.

8. Filtration: To determine the specific cake resistance and filter medium resistance in the given plate and frame filtration.
9. Elutriator: To study the sorting of a given mixture in an elutriator.
10. Cyclone Separator: Demonstration of the operation of a cyclone separator and determination of its overall collection efficiency.

Text Books:

1. McCabe W.L., Smith J.C. & Harriot P. Unit Operations in Chemical Engineering, McGraw-Hill, 7th Edition, 2004.
2. Harker J.H., Backhurst J.R. & Richardson J.F. Chemical Engineering - Volume 2, Butterworth-Heinemann, 5th Edition, 2002.

Subject Name: Instrumental Methods of Analysis Laboratory					
Paper Code: CHEN 2153					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**1.5**

Course Outcomes:

1. Given a sample of turbid water, students will be able to plot calibration curve (NTU vs. concentration) from samples of known turbidity and determine the turbidity of the unknown sample using Nephelo Turbidimeter.
2. Given a sample of pure protein, students will be able to plot calibration curve (Absorbance vs. concentration) using a spectrophotometer by Folin's Method.
3. Given a sample of ferric ion solution, students will be able to plot calibration curve (Absorbance vs. concentration) from samples of known Fe^{3+} concentration and determinethe Fe^{3+} concentration of the unknown sample using a Colorimeter.
4. Given a sample of water, students will be able to determine he dissolved Oxygen concentration using a DO meter.
5. Given a sample of ethanol-water mixture, students will be able to plot calibration curve (RI vs. concentration) from samples of known ethanol concentration and determine the Ethanol concentration of the unknown sample using Abbe Refractometer
6. Given a sample of dextrose-water solution, students will be able to plot calibration curve (Specific Rotation vs. concentration) from samples of known dextrose concentration and determine the dextrose concentration of the unknown sample using a Polarimeter.

Experiments to be performed:

1. Determination of Turbidity of Water using Nephelo Turbidimeter.
2. Construction of standard curve (Absorbance vs. concentration) of a pure protein byFolin's Method using Spectrophotometer.
3. Determination of Fe^{3+} in a solution by Colorimeter Method.
4. Determination of Dissolved Oxygen in water by DO Meter.
5. Estimation of Ethanol concentration in a mixture of Ethanol & Water by AbbeRefractometer.
6. Determination of concentration of any optically active substance in presence of nonactivespecies by a Polarimeter.
7. Determination of TDS of water sample by Conductivity Meter.
8. Demonstration of analysis of gas mixtures by Gas Chromatography.

Text/ Book of reference:

1. Dash D.C. Analytical Chemistry, PHI, 2nd Edition,2017

Subject Name: Heat Transfer					
Paper Code: CHEN 2201					
Contact Hours	L	T	P	Total	Credit Points
Per Week	3	0	0	3	3

Course Outcomes:
The objective of this course is to understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries. After completion of the course students will be able to:

1. Justify the practical importance and relevance of energy transfer and its conservation in chemical industry.
2. Categorize the technological methods related to heat transfer in process plant.
3. Identify a detailed overview of heat transfer equipment and problems associated at preliminary stage of design.
4. Construct a bridge between theoretical and practical concept used in industry.
5. Analyze heat transfer processes of industrial operation and identify modes of heat transfer.

Module I [10L]
Introduction to basic modes of heat transfer and their application in chemical process,
Heat transfer by conduction:
Fourier law, thermal conductivity, thermal resistance; general heat conduction equation, thermal diffusivity; steady state heat conduction with heat generation for plane wall, cylindrical body and spherical body;
Conduction-convection system:
Critical insulation thickness of curved surface, steady state heat conduction through fin, fin efficiency, unsteady state heat conduction in solid with large thermal conductivity, significance of Biot no and Fourier no, transient heat conduction in solid.

Module II [10L]
Convective heat transfer without phase change:
Newton-Rikhman law, local and average heat transfer coefficient, Reynold-Colburn analogy, concept of individual heat transfer coefficient and overall heat transfer coefficient, LMTD, empirical correlation for heat transfer coefficient in forced convection; elementary concept of thermal boundary layer, temperature distribution in laminar flow, analysis of free convection and correlation of free convection, Grash of number.

Module III [10L]
Heat transfer with phase change:
Film-wise and drop-wise condensation, laminar film condensation on vertical plate, Nusselt equation; analysis of heat transfer during boiling, different boiling regimes during pool boiling.
Characteristics of radiation, properties of radiating surface,
Black body radiation:
Plank's distribution law,
Total emissive power:

Stefan-Boltzman law, use of radiation function table; Wien's displacement law; Kirchoff's law; emissivity of black body, gray body and real body;

Radiation between surfaces:

View factor, Electrical network approach for radiation heat exchange, radiation shields and their application, radiation heat exchange for three radiating surfaces; radiation heat transfer through absorbing emitting medium.

Module IV [10L]

Heat exchangers and their classification,

Performance analysis of heat exchanger:

Fouling factor, LMTD correction factor, effectiveness and NTU of heat exchangers, sizing and rating problems of heat exchangers, construction details of shell and tube heat exchanger, Shell and Tube heat exchanger design, elementary note on heat exchanger network.

Evaporators and their classification, capacity and steam economy, Boiling Point Elevation (BPE), material and energy balance of single effect evaporator, classification of multiple effect evaporator, design of single effect and multiple effect evaporator.

Text Books:

1. Kern D. Q. Process Heat Transfer, Tata McGraw-Hill, 1997.
2. Dutta B. K. Heat Transfer Principles and Application, PHI Learning Pvt. Ltd., 2015.
3. McCabe W.L., Smith J.C. & Harriot P. Unit Operations of Chemical Engineering, McGraw-Hill, 7^{th} edition, 2017.

Books of reference:

1. Ozisik M. N. Heat Transfer: A Basic Approach, McGraw-Hill International Edition, Singapore, 1984.
2. Sikdar D.C. Process Heat Transfer & Chemical Equipment Design, Khanna Publishing House, 1^{st} Edition, 2018.

Sulagna Chatterjee

Subject Name: Thermodynamics II					
Paper Code: CHEN 2203					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

To introduce the concepts of fugacity, activity coefficient, vapour -liquid equilibrium, reaction equilibrium, and introduction to molecular thermodynamics. After completion of the course students will be able to:

1. Ability to understand the basic knowledge that allows the students to solve problems relating fugacity of pure components as well as in mixture.
2. Ability to utilize the concept of chemical potential as criterion of phase equilibrium.
3. Ability to use concept of partial molar properties in solution thermodynamics.
4. Ability to understand the basic knowledge that allows the students to solve problems on equilibrium of different phases involving no chemical reaction.
5. Ability to understand the basic knowledge that allows the students to solve problems on chemical reaction equilibrium.

Module I [10L]

Review of first and second law of thermodynamics:

First law for closed and open systems (steady and unsteady), entropy and second law, principle of maximum entropy.

Thermodynamic property of pure substances and mixture:

Residual properties, fugacity and fugacity coefficient/in solution, relation between fugacity coefficient and compressibility factor , chemical potential, chemical potential as criterion of phase equilibrium, free energy and chemical potential, excess properties, numerical problems.

Module II [10L]

Solution thermodynamics:

Concept of partial molar properties, Gibbs- Duhem equation, fundamental excess property relation, evaluation of partial properties, property change on mixing,

Vapour –liquid equilibrium:

Phase rule, simple models for VLE, VLE by modified Raoult’s law, VLE from K- value correlations, Numerical problems.

Module III [10L]

Application of Solution thermodynamics:

Liquid phase properties from VLE data,

Non-ideal VLE:

Models for excess Gibbs free energy, UNIFAC and UNIQUAC models, property changes of mixing, heat effect of mixing processes, liquid- liquids equilibrium, solid liquid equilibrium, vapour-liquid-liquid equilibrium, solid-vapour equilibrium, numerical problems.

Module IV [10L]

Chemical reaction equilibrium:

Reaction coordinate, equilibrium criterion, equilibrium constant, effect of temperature on equilibrium constant, evaluation of equilibrium constant, equilibrium conversion of single reaction, multi reaction equilibria, numerical problems.

Introduction to molecular thermodynamics:

Postulates; microcanonical, canonical and grand canonical ensembles; non-interacting examples. Partition function, second virial coefficients from potential functions, internal energy of ideal gases- microscopic view, thermodynamic and statistical mechanics.

Text Book:

1. Smith J.M., Van Ness H.C. & Abbott M.M. Introduction to Chemical Engineering Thermodynamics, McGraw-Hill International Edition, 7th. Edition, 2005.

Books of reference:

1. Sandler S. Chemical, Biochemical and Engineering Thermodynamics, Wiley, 5th. Edition, 2017.
2. Kyle B.G. Chemical Process Thermodynamics, Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Edition, 2000.
3. Narayanan K.V. A Text Book Chemical Engineering Thermodynamics, PHI Learning Pvt. Ltd, 2013.
4. Rao Y.V.C. Chemical Engineering Thermodynamics, University Press (India) Ltd. Reprint, 2004.

Subject Name: Material Science					
Paper Code: CHEN 2204					
Contact Hours	L	T	P	Total	Credit Points
Per Week	3	0	0	3	3

Course Outcomes:

The objective of this course is to impart basic knowledge and provide strong foundation to the learners on the processing, structural aspects, properties and functional applications of traditional and advance materials of the modern day. After completion of this course students will be able to:

1. Understand structure of various materials and inherent defects.
2. Identify the mechanical, electronic and optical properties of various materials
3. Classify different metal extraction processes from their ores.
4. Analyze solid and liquid phase behavior from phase equilibrium study.
5. Explain the process flow in the manufacturing/extraction of relevant metal/alloy.

Module I [10L] Structure of materials:

Various types of bonds; Crystalline Structure of Solids- concepts of unit cell and space lattice, packing factor; Classification of materials, Selection of materials.

Mechanism of plastic deformation, slip and twinning,

Structural imperfections:

Elementary concepts of point, line, surface & volume imperfections; Influence of dislocations/Line imperfections on the mechanical properties of materials**;** Strain hardening and recrystallization; Elementary aspects of creep, fatigue fracture.

Module II [10L]

X- ray diffraction for determining crystal structure;

Mechanical properties:

Strength, hardness, toughness, ductility, brittleness of Engineering Materials**;** Elastic, Anelastic and visco-elastic behaviour of materials; Electrical, Electronic, Magnetic, Optical & Optoelectronic properties of material; Inorganic & organic amorphous materials and their structural & property characteristics; Optical fibers.

Phase Diagrams:

Solidification and structure of metals, Grain boundaries; Phase equilibrium and phase diagrams of binary alloys; Phase diagram of ternary systems; Iron-Carbon diagram;

Heat Treatment:

Introduction and purposes of heat treatment; T-T-T diagram; Corrosion-Concepts and forms of corrosion; Corrosion Mechanism and prevention; Protective materials and coating.

Module III [10L]

Basic principles of metal extraction:

Pyrometallurgy: Smelting, calcinations, roasting— oxidizing, predominance area diagrams, multiple hearth, flash and fluo-solid, sintering, smelting, slag and its classification.

Iron making in Blast furnace,

Steelmaking process flow diagram:

Steel making (oxygen blown converter –LD) – Secondary steel making / refining (ladle processing, vacuum degassing, ladle furnace processing) – Continuous casting – with emphasis on application of the concepts of

Sutapa Chatterjee

physicochemical principles involved, moving/packed bed reactor, gas-liquid two-phase flow, heat transfer with phase change (solidification).

Module IV [10L]
Principles of Hydrometallurgy and Electrometallurgy,
Extraction of Aluminum:
Hall-Heroult process, Electrolytic refining, Pyro & Hydro metallurgical extraction of copper & Zinc; Extraction of Lead, Nickel, Titanium, Recent advances on nanomaterials.

Text Books:

1. Raghavan V. Material Science and Engineering, Prentice-Hall of India Pvt. Ltd., 5th Edition, 2004.
2. Ray H.S., Sridhar R. & Abraham K.P. Extraction of nonferrous metal, Affiliated East- West Press Pvt. Limited, 2008.
3. Callister W.D. Jr & Rethwisch D.G. Material Science and Engineering: An Introduction, John Wiley & Sons, 8th Edition, 2010.
4. Smith W.F., Hashemi J. & Prakash R. Material Science and Engineering, McGraw Hill Education, 5^{th} Edition, 2017.

Books of reference:

1. Vlack L.H.V. Elements of Material Science and Engineering, Addison-Wesley Educational Publishers Inc., 1980.
2. Lakhtin Y. & Weinstein N. Engineering Physical Metallurgy, MIR Publishers, Moscow, 1975.
3. Bogdandy L.V. & Engell H.J. The Reduction of Iron Ores, Springer-Verlag, New York, 1971.
4. Guthrie R.I.L. Engineering in Process Metallurgy, Oxford University Press, 1992.

<table>
<tr><td colspan="6">Subject Name: Heat Transfer Laboratory</td></tr>
<tr><td colspan="6">Paper Code: CHEN 2251</td></tr>
<tr><td rowspan="2">Contact Hours Per Week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>3</td><td>1.5</td></tr>
</table>

Course Outcomes:

The objective of this course is to provide the practical exposure to the students regarding the application of various heat transfer phenomenon and correlations in various engineering processes. Hands on experience will enable them to analyze working principles of various heat transfer devices including heat exchangers, condensers. After completion of this course students will be able to:

1. Identify different modes of heat transfer and basic laws of heat transfer.
2. Analyze problems involving steady state heat conduction and develop solutions for transient heat conduction in simple geometries.
3. Identify the fundamentals of convective heat transfer process.
4. Evaluate the heat transfer coefficients for forced convection inside duct.
5. Analyze radiation heat transfer between black body surfaces.
6. Analyze heat exchanger/ condenser performance.

Experiments to be performed:

1. Determination of thermal conductivity of a metal bar using Fourier's heat conduction equation.
2. Estimation of heat loss through a lagged pipe and determination of thermal conductivity of insulating material.
3. Determination of heat transfer coefficient of air during heat transfer by forced convection and to study the effect of air velocities on heat transfer co-efficient.
4. Determination of overall heat transfer coefficient in a counter current / parallel flow double pipe heat exchanger and to study the effect of fluid flow rate on overall heat transfer coefficient.
5. Determination of overall heat transfer coefficient and efficiency of a shell and tube heat exchanger and to study the effect of fluid flow rate on overall heat transfer co-efficient.
6. Determination of Stefan Boltzmann constant experimentally.
7. Determination of Biot number for a conductive convective system and validation of lumped system assumption.
8. Determination of heat transfer co-efficient in film-wise & drop-wise condensation.
9. Determination of emissivity of a given radiating surface by applying Kirchhoff's law of thermal radiation.

Subject Name: Programming Basics for Numerical Computation					
Paper Code: CHEN 2252					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	1.5

Course Outcomes:
The objective of this course is to build up the basic knowledge on the programming skill with MATLAB/OCTAVE in order to solve mathematical model relating any chemical engineering process. After completion of the course students will be able to:

1. Generate the algorithm to solve a simple mathematical problem.
2. Formulate the logic required to solve the problem.
3. Generate code for the implementation of the algorithm with the knowledge of the logic required.
4. Read data from formatted input file for further processing of it through written code.
5. Execute loops, functions comparison operations.
6. Analyze the output of the program by representing the output in graphical format.

Programmes to be performed using MATLAB / OCTAVE:

1. Introduction to MATLAB/OCTAVE interface. Execution of statements from command lines, data input for scalars, 1D and 2D arrays, extract elements of arrays, evaluate array size.
2. Write and execute programs through .m file (editor file). Call in-built functions in MATLAB/OCTAVE.
3. Concept of loops (for, while and do-while), “break” and “continue” statement.
4. Usage of comparison operators and conditional statements (if, else andelseif).
5. Write a program to find out the adjoint and transpose of a 2Darray.
6. Write a program to find out the determinant and inverse of a 2Darray.
7. Write a program to check whether a matrix is diagonally dominant or not?
8. Writeaprogramtoplotthevariationofyw.r.t.xforadifferentialequation

$$\frac{dy}{dx} = \exp(-x)$$

using Euler’s method. Given at y(0)=1.

Text Books:

1. Pratap R. Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers, Oxford, 2010.
2. Nagar S. Introduction to Octave: For Engineers and Scientists, Apress, 1st Edition, 2017.

Books of reference:

1. Attaway S. Matlab: A Practical Introduction to Programming and Problem Solving, Butterworth-Heinemann, 3rd Edition, 2013.
2. Nakamura S. GNU Octave Primer for Beginners, Create space Independent Publishing Platform, 2nd Edition, 2016.

Subject Name: Engineering Drawing Laboratory					
Paper Code: CHEN 2253					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course Outcomes:

The objective of the course is to provide an elaborated concept of engineering drawing and idea on the relevant software for engineering drawing. After completion of the course studentswill be able to:

1. Student will be able to understand basics of engineering drawing.
2. Student will be able to draw different angular projection view of engineering equipment.
3. Students will be able to draw isometric projection view of engineering equipment.
4. Students will be able to draw cut-section view of engineering equipment.
5. Students will be able to use AutoCAD software for developing engineering drawing layouts.
6. Students will be able to prepare a virtual 3-D representation of an engineering equipment.

Problems to be solved:

1. Introduction to AutoCAD software for drawing in 2D: Drawing and editing commands. Knowledge of setting up layers, dimensioning, hatching, making block, plotting and printing, working with external reference file.
2. Drawing any three of the following item using AutoCAD software.
3. Flange coupling for shaft and vessel or pipe.
4. Pipe joints and fittings, single line and double line pipe line assembly.
5. Stuffing box.
6. Detailed cut section drawing of Globe valve and Stop valve.
7. Piping and instrumentation diagram of any given chemical process.
8. Assembly drawing of a single stirred jacketed pressure vessel with all its accessories using AutoCAD software.
9. Introduction to AutoCAD software for drawing in 3D: Working in 3- dimensions, Drawing and editing commands, viewing 3D objects, basic solid and wireframe models, extruding, simple revolved objects. Generation of orthographic projections from 3D drawing.

Books of reference:

1. VenugopalK.,EngineeringDrawingandGraphics+AutoCAD,NewAgeInternational (P) Limited, Fourth edition, 2001.

2. Agarwal B. & Agarwal C.M., Engineering Drawing, McGraw Hill Education (India) Private Limited, 2nd Edition, 2014.
3. Lockhart S., Tutorial Guide to AutoCAD 2016, SDC Publication, 2016.

CIRCUIT THEORY

CODE: ELEC2101 **Contact: 3L+1T**

Credit: 4

COURSE OUTCOMES:

The students will be able to

- apply network theorems to solve electrical circuits having both dependent and independent sources.
- analyze magnetically coupled circuits.
- apply Laplace transform technique in solving transient problems of electrical circuits.
- apply the concept of graph theory to electrical circuits.
- obtain the equivalent representation of electrical circuits using two- port parameter representation.
- analyze and synthesize filters.

Module-I

Network equations: Formulation of Node & Mesh equations. Loop and node variable analysis of transformed circuits. Network Theorems: Superposition, Thevenin, Norton and maximum power transfer theorem applied to circuits containing dependent sources. [7L]

Coupled Circuits: Coefficient of coupling, Dot convention, Analysis of coupled circuits. [3L]

Module-II

Laplace Transform: Concept of complex frequency. Properties of Laplace transform linearity, differentiation, integration, initial value theorem and final value theorem. Transform of standard periodic and non periodic waveforms. Circuit elements and their transformed equivalents, independent and dependent sources, Transient and steady state response of RL, RC, LC and RLC with or without stored energy. Treatment of mutual couplings in t & s domain. Concept of natural frequency and damping. Sketching of transient response. [10L]

Module-III

Graph theory: Graph of network: Concept of path, tree, tree branch, tree link, loop, tie set and cut set. Incidence Matrix, Tie-set Matrix and f-cut set matrix and their properties. Loop currents and node-pair potentials, formulation of loop and node equilibrium equations in view of graph theory. [6L]

Two port networks: Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and inverse hybrid parameters. Inter relation between parameters. Inter connection between two port networks. Driving point & transfer impedance & admittance. [6L]

Module-IV

Filter Circuits: Concept of filters, Classification of filters. Analysis and synthesis of Low pass, High pass, Band pass and Band reject filters using operational amplifier. Filter approximations: Butterworth and Chebyshev filters. [8L]

Total: 40L

Text Books:

1. Networks and Systems, D. Roy Chowdhury, New Age International Publishers
2. Network Analysis, M.E. Valkenburg, Pearson Education
3. Circuit theory, Dr. Abhijit Chakrabarty, Dhanpat Rai & Co Pvt. Ltd.
4. Fundamental of Electric circuit theory, D. Chattopadhay & P.C. Rakshit, S. Chand.

Reference Books:

1. Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin,The Mc Graw Hill Company.
2. Modern Network Analysis, F.M.Reza & S.Seely, McGraw Hill.

HOD, EE

ANALOG & DIGITAL ELECTRONICS

CODE: ELEC2102 **CONTACT: 4L**
Credit: 4

COURSE OUTCOME

After successful completion of the course the students will be able to do the following:

- Recall basic principles of diodes, transistors and OPAMPs.
- Understand basic principles of OPAMP based circuits for linear and nonlinear operations and analyze their implications.
- Acquire knowledge about different waveform generators, 555 timers, ADCs and DACs and their applications.
- Recall number systems and Boolean algebra.
- Understand Boolean algebra based realisation of logic gates and design of various arithmetic and combinational circuits.
- Design and analyze various sequential circuits like synchronous and asynchronous counters, shift registers using flip flops.

Module-I

Semiconductor devices:

Review of diodes, transistors.
Recall Transistor amplifiers: Biasing and Equivalent circuit.
Review of Operational amplifiers (OPAMP). Basic building blocks of OPAMP, Ideal OPAMP characteristics, Specifications of OPAMP.
Concept of feedback. Analysis of practical feedback amplifiers.
Realization of different OPAMP based practical circuits: integrators, differentiators etc. Use of OPAMP to realise linear differential equations.

Non-linear applications of operational amplifiers:

Comparators, zero crossing detectors, Schmitt triggers, precision rectifiers, peak detectors, clippers and clampers. **[12L]**

Module-II

Waveform generators using operational amplifiers:

Oscillators: Barkhausen criteria; Phase shift oscillator, Wien Bridge oscillator, Colpitts oscillator, Hartley oscillator**,** crystal oscillator.
Multivibrators: Astable, monostable and bistable multivibrators.
Triangular and saw-tooth wave generator, voltage controlled oscillator (VCO).

555 timer:

Functional diagram of 555 timer, design of astable and monostable multivibrators using 555 timer. **[8L]**

Module-III

Data, Number Systems: Concept of digital data, Review of number systems and codes.
Boolean Algebra: Elementary logic gates (NOT, AND, OR, NOR, NAND, XOR and XNOR), their truth tables and circuits, Universality of NOR and NAND gates, Boolean algebra, De-Morgan's Theorem and applications, Representation of logical statement into Boolean expression and realization using logic gates, Representation of logical expression in SOP and POS forms, Minimization of logic expressions by algebraic method, K-map method.

HOD, EE

Combinational Circuits: Adder, Subtractor, Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer, Parity Generator and Code Converters. **[10L]**

Module-IV

Sequential Circuits: Basic memory elements, Latch and Flip Flop, S-R, J-K, D, and T Flip flop, Conversion of one flip flop into other flip flops.

Counters & Their Design: Asynchronous and Synchronous counters and their realization using flip flops, Ring Counters.

Registers: Shift registers, parallel load and serial load.

Converters: Different types of A/D and D/A conversion techniques.

Logic families: TTL, ECL, MOS & CMOS, their operation and specification. **[10L]**

Text Books:

1. Adel S. Sedra & Kenneth Carless Smith, Microelectronic Circuits, Oxford University Press
2. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Prentice Hall of India Private Limited
3. H. Taub, D. Schilling, "Digital Integrated Electronics", McGraw-Hill Kogakusha Ltd.
4. Fundamental of Digital Circuits, A. Anand Kumar, PHI.
5. Digital Circuits and Design, 4th Edition, S. Salivahanan & S. Arivazhagan, Vikas Publishing House Pvt Ltd.

References:

1. Robert L. Boylestad, Electronic Devices and Circuit Theory, Prentice Hall
2. Millman & Halkias: Integrated Electronics.
3. Modern Digital Electronics, 2nd Edition, R.P. Jain. Tata McGraw Hill Company Limited
4. S. Salivahanan and V.S. Kanchana Bhaaskaran. Linear Integrated Circuits, Tata McGraw Hill Company Limited

HOD, EE

ELECTRICAL & ELECTRONIC MEASUREMENT

CODE: ELEC2103 **CONTACT: 3L**
Credit: 3

The students will be able to

- understand the mechanism and operating principles of various deflecting type measuring instruments and extension of their ranges.
- define and classify various errors in measurement.
- acquire knowledge of various power and energy measuring devices
- understand the operating principles and applications of instrument transformers and potentiometers
- acquire knowledge about and analyze various ac and dc bridges for measuring different electrical parameters and their applications.
- acquire knowledge about various electronic and digital instruments like average reading AC voltmeters, peak reading AC voltmeters, true RMS voltmeter, electronic multi-meter, digital voltmeters.

Module-I
Electrical Instruments:
Introduction, Classification of electrical measuring instruments. Construction, Principle of operation, torque equation, advantage and disadvantage of Moving coil, Moving iron, Electrodynamometer type and Induction type instruments. Extension of instrument ranges and multipliers, Principle of operation of the Electrostatic Instruments. [8L]
Errors in Measurement:
Definition of accuracy, precision, speed of response, Instruments' hysteresis, classification of errors, Absolute Error and Limiting Error. [2L]

Module-II
Measurement of Power:
Power measurement by Electrodynamometer type wattmeter, construction, principle of operation, shape of scale, wattmeter connections and errors. [3L]
Measurement of Energy:
Induction type energy meter: Principle of operation, errors and their compensation. [3L]
Instrument transformer:
Disadvantage of shunt and multipliers, Advantage of Instrument transformers, Construction, Principle of operation, Equivalent circuit and Vector diagram of Current & Potential transformer, Errors in Current Transformer and Potential Transformer. [4L]

Module-III
Measurement of Resistance:
Wheatstone Bridge, Low resistance measurement by Kelvin double Bridge, High resistance measurement, Megger. [2L]
Measurement of Inductance, Capacitance and Frequency:
Maxwell's Bridge, Anderson Bridge, Owen's Bridge, De Sauty's Bridge, Schering Bridge and Wien Bridge. [2L]
Potentiometer:

HOD, EE

Principle of operation and application of Crompton's DC potentiometer, Polar and Co-ordinate type AC potentiometer & Application. [4L]

Module-IV

Localization of cable fault: Murray loop test, Varley loop test. [2L]

Electronic Instruments:

Average reading AC voltmeters, peak reading AC voltmeters, true RMS voltmeter, Electronic multi-meter. [3L]

Digital Voltmeter: Integrating type using voltage to time and voltage to frequency conversion techniques and Successive approximation type. [3L]

TOTAL-36L

Text Books:

1. A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & sons.
2. Electrical Measurement & Measuring Instruments, E.W. Golding & F.C. Wides, Wheeler Publishing.
3. Electronic Instruments, H.S. Kalsi, Tata Mc-Graw hill, 2nd Edition.
4. Modern Electronic instrumentation & Measuring instruments, A.D. Heltric & W.C. Copper, Wheeler Publication.
5. Electrical and Electronic Measurement, N.K.Dutta

HOD, EE

MECH 2106: Mechanics for Engineers

Contacts: 3 L **Credits: 3**

Course Outcome:

After going through the course, the students will be able

- Understand basic concepts of vector algebra as applied to engineering mechanics.
- Draw free body diagram of a system under equilibrium.
- Understand friction phenomenon and calculate friction loss.
- Understand and quantify elastic behavior of deformable bodies.
- Know how to calculate the CG location required for design of structures.
- Apply the principles of work-energy for analysis of dynamic systems.

SL. No	Syllabus	Contacts Hrs.
Module 1	Importance of Mechanics in Engineering ; Definition of Mechanics; Concepts of particles & rigid bodies;	1
	Vector and scalar quantities; Vector algebra –definition and notation; Types of vectors – equal , equivalent , free , bound , sliding ; Addition , subtraction of vectors ; Parallelogram law , triangle law , vector polygon ; Scalar multiplication of vectors ; Resolution of vectors in Cartesian co–ordinate system ; Unit vector, unit co–ordinate vectors ($\hat{i}, \hat{j}, \hat{k}$) ; Direction cosines ; Addition/ subtraction of vectors in components form.	3
	Dot product , cross product and the application ; Important vector quantities (position vector , displacement vector, velocity vector, acceleration vector, force vector);	1
	Force, Moment of a force about a point and about an axis , moment of a couple ; Representation of force and moments in items of $\hat{i}, \hat{j}, \hat{k}$. Principle of transmissibility of force (sliding vector); Varignon's theorem for a system of concurrent forces with proof; Resolution of a force by its equivalent force-couple system; Resultant of forces.	5
Module 2	Type of forces – collinear, concurrent, parallel, concentrated, distributed; Active and reactive forces, different types of reaction forces; Free body concept and diagram; Concept and equilibrium of forces in two dimensions; Equations of equilibrium; Equilibrium of three concurrent forces -- Lami's theorem.	7
	Concept of friction: Laws of Coulomb's friction; Angle of friction, angle of repose, coefficient of friction -- static and kinetic.	3

Module 3	Distributed force system; Centre of gravity; Centre of mass & centroid; Centroid of an arc; Centroid of plane areas – triangle, circular sector, quadrilateral and composite area consisting of above figures. Concept of simple stress and strain ; normal stress , shear stress , normal strain, shear strain; hooke's law; poisson's ratio; stress- strain diagram of ductile and brittle material; proportional limit, elastics limit, yield point , ultimate stress, breaking point,; modulus of elasticity. Factor of safety for design calculations.	4 6
Module 4	Introduction to dynamics: Kinematics & kinetics; Newton's laws of motion; Law of gravitation and acceleration due to gravity; Rectilinear motion of particles with uniform & non – uniform acceleration. Plane curvilinear motion of particles: Rectangular components (projectile motion). Principle of work & energy; Principle of conservation of energy.	4 3 2
	Total	**39**

Recommended books:-

1. Engineering Mechanics:- Statics and Dynamics by Meriam & Kreige , Wiley india
2. Engineering Mechanics:- Statics and Dynamics by I.H. Shames, P H I
3. Engineering Mechanics by Timoshenko , Young and Rao , TMH
4. Fundamentals of Engineering Mechanics by Nag & Chanda – Chhaya Prakashani.

HOD, EE

CIRCUIT THEORY LABORATORY

CODE: ELEC2151 **Contact: 2P**

Credit: 2

COURSE OUTCOMES:

The students are expected to

- Learn simulation of electrical circuits.
- gain knowledge of transient and frequency response of electrical circuit.
- find out open circuit impedance parameter and short circuit admittance parameter of two port network experimentally.
- design and synthesize filters.

List of Experiments:

1. Determination of Laplace transform and Inverse Laplace transform using MATLAB.
2. Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB/OCTAVE in analog form.
3. Representation of Poles and Zeros in s-plane, determination of partial fraction expansion from cascade form and vice versa in s-domain using MATLAB/OCTAVE.
4. Transient response of R-L and R-C network.
5. Transient response of R-L-C series and parallel circuit.
6. Verification of Network theorems.
7. Determination of Impedance (Z) and Admittance (Y) parameter of a two port network.
8. Design of Butterworth Low Pass and High Pass filters: Simulation and Hardware implementation
9. Design of Band Pass and Band Reject filters using Butterworth Low Pass and High Pass filters: Simulation and Hardware implementation.

HOD, EE

ANALOG & DIGITAL ELECTRONICS LABORATORY

CODE: ELEC2152 **Contact: 2P**
Credit: 1

Course Outcomes:

After completion of the course the students will be able to:

- Realize OPAMP as inverting and non-inverting amplifier, adder, subtractor, integrator, differentiator.
- Realize OPAMP as comparator, zero crossing detector, Schmitt trigger.
- Realize astable and monostable multivibrator using OPAMP.
- Realize astable, monostable and bistable multivibrator and VCO using 555 timer.
- Analyze different types of digital electronic circuit using various mapping and logical tools and know the techniques to prepare the most simplified circuit using various mapping and mathematical methods.
- Apply the design procedure to design and implement various combinational and basic sequential circuits.

Experiments on Analog Electronic Circuit:

1. Transfer characteristics of an inverting and non-inverting amplifier using operational amplifier.
2. Realization of adder and subtractor using operational amplifier.
3. Realization of integrator and differentiator using operational amplifier.
4. Transfer characteristics of zero crossing detector, comparator with hysteresis using operational amplifier.
5. Realization of astable and monostable multivibrator using operational amplifier.
6. Realization of astable and monostable multivibrator using 555.
7. Design of bistable multivibrator and VCO using 555.

Experiments on Digital Electronic Circuit:

8. Realization of logic statement using universal logic gates.
9. Construction of decoder and encoder using logic gates.
10. Realization of MUX and DMUX using logic gates.
11. Realization of SR, D, JK and T Flip Flop.
12. Realization of binary, BCD counters (synchronous and asynchronous).
13. Construction of shift registers using Flip Flops.
14. Familiarization experiments on DAC0808 & ADC0808.

HOD, EE

ELECTRICAL AND ELECTRONIC MEASUREMENT LABORATORY

CODE: ELEC2153 **CONTACT: 2P**

Credit: 1

Course Outcome:

Students will be able to

- calibrate analog ammeter, voltmeter and wattmeter using dc potentiometer.
- measure unknown resistance, inductance, capacitance and frequency using different dc and ac bridges.
- use instrument transformer for measuring power consumption of connected load using standard available measuring meters.
- calculate energy consumption of single phase system and power measurement of three phase system.

List of Experiments:

1. Familiarization of instruments: Identification of the different parts of PMMC, Dynamometer, Electro-thermal and Rectifier type of instruments. Oscilloscope and Digital multi-meter.
2. Calibration of moving iron and electrodynamometer type ammeter/voltmeter by potentiometer.
3. Calibration of dynamometer type wattmeter by potentiometer.
4. Calibration of AC energy meter.
5. Measurement of resistance by Kelvin double bridge.
6. Measurement of Power and use of Instrument transformer to extend the range of power measuring instruments.
7. Measurement of power in Three-phase circuits.
8. Measurement of frequency by Wien Bridge.
9. Measurement of Inductance by Anderson Bridge.
10. Measurement of capacitance by De-Sauty Bridge.
11. Measurement of capacitance by Schering Bridge.

HOD, EE

ELECTRICAL MACHINE-I

CODE: ELEC2201 **CONTACT: 3L+1T**
Credit: 4

Course Outcome:

The students will be able to:

1. Understand the fundamental principle of electromechanical energy conversion.
2. Acquire knowledge about the constructional details, principle of operation, excitation types in dc machines.
3. Understand the working of dc machines and acquire knowledge about testing on dc machines.
4. Acquire knowledge about the constructional details, principle of operation, performance analysis and testing of single phase transformers.
5. Understand different types of connections of three phase transformers.
6. Understand and analyze the performance of three phase transformers.

Module-I [9L]

Principles of Electromechanical Energy Conversions:

Conversion of Energy: Introduction, Production of EMF, Production of Force, Flow of Energy in Electromechanical devices, Energy stored in Magnetic Systems.
Singly Excited Machine: Determination of Mechanical Force, Mechanical Energy, Torque Equation.
Doubly Excited Machine: Determination of Mechanical Force, Mechanical Energy, Torque Equation.

Fundamentals of DC Machine:

Working Principle: Introduction, Production of EMF in Elementary DC Generator, Production of Torque in Elementary DC Motor.
Construction of DC Machine: Basic idea of Yoke, Poles, Armature, Commutator and brush, Armature Windings, Materials used.
EMF and Torque in DC machine: Generation of EMF in DC machine, Torque developed in DC Machine, Counter torque and Counter EMF.
Methods of Excitations: Shunt, Series and Compound excitation.

Module-II [11L]

DC Machine:

Flux density waveform in DC machine: Armature reaction & its effects, Methods of limiting the Armature reaction, Commutation Process, Methods of commutation.
DC Generator: Voltage build up of dc shunt generator, Characteristics with different excitation systems, Voltage regulation, Parallel Operation.
DC Motor: Characteristics and applications of Separate, Shunt, Series and Compound motors, Methods of starting, speed control, equivalent circuit. Series-parallel operation of motors, Braking in DC Motor.
Testing of DC Machine: Brake test, Swinburne test, Hopkinson's test.

HOD, EE

Module-III **[11L]**

1-ph Transformer:

Basic Principle of Transformer: Faraday’s law of electromagnet induction, Basics idea of magnetic circuits, Mutual and Leakage Flux, Concept of ideal Transformer and its assumptions.
Construction of Transformer: Magnetic Circuit, Windings, Insulation, Different types of cooling, Tank and radiator construction, Transformer oil, Transformer accessories, eg., conservator, breather, Bucholtz relay, bushing, etc. Tap changer.
Performance of Transformer: Operation of real Transformer under load, Equivalent circuit and phasor diagram, per unit system of representation, Voltage regulation, Efficiency, Effects of changes of frequency and voltage on transformer performance, Rating of Transformer.
Testing of Transformer: OC and SC test, separation of losses, determination of equivalent circuit parameters.
Parallel Operation of Transformers: Conditions, Load sharing.
Single phase Auto Transformer: Principle of operation, phasor diagram. Comparison of weight, Copper loss equivalent reactance with 2-winding transformer.

Module-IV **[9L]**

3-ph Transformer:

Different Connections: Introduction, Different Vector groups, 3-phase to 6-phase conversion, 3-phase to 2-phase conversion, Open delta, Grounding Transformer.
Performance of 3-phase Transformer: Production of Harmonics in Transformer and its suppression, Effect of harmonics on different types of 3-phase Transformer, Unbalanced loading on 3-phase transformer.

Text Books:
1. Electrical Machinery by Dr. P.S. Bimbhra.
2. Generalized Theory of Electrical Machines by Dr. P.S. Bimbra.
3. Electrical Machines by P. K. Mukherjee & S. Chakravorty.
4. Electrical Machinery by S.K.Sen.
5. Theory of Alternating Current Machinery by Alexander S Langsdorf.

Reference Books:
1. The Performance and Design of Direct Current Machines by Clayton & Hancock.
2. The Performance and Design of Alternating Current Machines by M.G.Say.
3. A Textbook of Electrical Machines by K. R. Siddhapura &D. B. Raval.
4. Electrical Machines by Prithwiraj Purkait & Indrayudh Bandyopadhyay.

HOD, EE

SIGNALS AND SYSTEMS

CODE: ELEC2202 **CONTACT: 3L**
Credit: 3

COURSE OUTCOMES:
Students will be able to

- Understand the concept of signals and analyze the spectral content in periodic and aperiodic signals.
- Understand the impulse response of a system, convolution of two signals and its application to dynamic systems.
- Understand the concept of sampling of a signal; obtain the output of a system using z − transform.
- Describe the mathematical model of physical systems and understand the concept of BIBO stability.
- Possess a basic understanding of the concept of frequency response and time response of dynamic systems and analyze their implications.
- Describe the mathematical model of dynamical systems in state-space form and its time domain solution using the concept of "state transition matrix".

Module-I
Signals: Concept of Signals, Continuous and discrete time signals, Classification of Signals:Periodic and aperiodic, even and odd, energy and power signals, Deterministic and randomsignals, Exponential, sinusoidal signals. Decomposition of signals into odd and even components. Singularity functions- step, ramp, impulse and doublet signals. Properties of Impulse Function. Decomposition of simple aperiodic waveforms in terms of singularity functions. Transformation of signals: time scaling; time shifting. Convolution Theorem. **[5L]**

Fourier Series & Transform: Dirichlet's conditions, Fourier series-trigonometric and exponential.Gibbs Phenomenon, Fourier transform of aperiodic functions. Generalized Fourier transform. Properties of Fourier transform. **[5L]**

Module-II
Sampling: Representation of continuous time signals by its samples- Types of sampling, Sampling theorem. Reconstruction of a signal from its samples, aliasing. **[3L]**

Z-Transforms: z-transform definition, mapping between s-plane and z-plane, unit circle in z plane, region of convergence (ROC), Properties of z-transform, Poles and Zeros, inverse z-transform using Residue Theorem, Power Series expansion and Partial fraction expansion. **[5L]**

Module-III
Systems: Concept of Systems, Classification, Differential equation representation of systems, Definition of Linear Time invariant (LTI) systems. Concept of transfer function, Poles and zeros. Concept of BIBO stability of a system. Time and frequency response of first and second order systems. **[5L]**

Modeling of Dynamic Systems: Mechanical systems (translational systems and rotary systems) electromechanical systems (DC Servo motor and PMMC). Electrical analogous systems. **[5L]**

HOD, EE

Module-IV

State space analysis: State variable representation of systems, Normalization of linear equations. Converting higher order linear differential equations into State Variable (SV) form. Obtaining SV model from Transfer Function. Obtaining characteristic equations and transfer functions from SV model. State variable representations of electrical and mechanical systems. Solutions of state equations. State transition matrix. Properties of state transition matrix. **[8L]**

Total: 36L

Text Books:

1. Signal Processing & Linear Systems, B.P.Lathi, Oxford
2. Signals and Systems, A.NagoorKani, McGraw Hill
3. Signals and Systems, S.Haykin&B.V.Veen, John Wiley
4. Signals and Systems, T.K.Rawat, Oxford

Reference books

1. Kuo, B. C; "Automatic Control System" Prentice Hall of India
2. Lindner D. K; "Introduction to signals and systems", McGraw Hill
3. C-T Chen- Signals and Systems- Oxford
4. Network Analysis & Synthesis, F.F Kuo., John Wiley & Sons

HOD, EE

Type text

BASIC THERMAL POWER ENGINEERING

Code: ELEC2203 **Contacts: 4L**

Credits: 4

Course Outcome:

After going through the course, the students will be able to

- Analyze a thermodynamic system and calculate work transfer in various quasi-static processes , Understand the difference and correlation between heat transfer and work transfer
- Read and interpret the values of properties of water/steam from steam table and Mollier chart for evaluation of heat transfer and work transfer in processes involving steam
- Understand the basics of thermal power generation and calculate the efficiencies of Rankine cycles with reheat and regeneration
- Understand various types of boilers used in thermal power plants and draw up a heat balance sheet and design the chimney height based on various conditions.
- Calculate power output , blading efficiency , staging efficiency from Impulse and Reaction turbines and appreciate the importance of compounding and governing of turbines.
- Calculate the water requirement for power plant, power required to drive fans, condenser efficiency.

.

Sl. No.	Syllabus	Contact Hrs
Module 1	**Basic concepts of Thermodynamics:** Introduction; Definition of Thermodynamic systems; System boundary, universe; Open, closed and isolated systems; Control mass and control volume; State; Definition of properties: intensive, extensive & specific properties.	1
	Thermodynamic equilibrium : Change of state; Thermodynamic processes; Quasi-static processes; Thermodynamic cycles; Zeroth law of Thermodynamics -concept of temperature.	1
	Heat & Work: Definition and units of Thermodynamic work; Work transfer-displacement work for a simple compressible system, path function, Pdv work in various quasi-static processes(isothermal, isobaric, adiabatic, polytropic, isochoric); Free expansion; Net work done by a system in a cycle. Definition and unit of heat; Heat transfer-a path function; Similarities and dissimilarities between heat and work.	2
	First law of Thermodynamics: For a closed system executing a cycle; Concept of stored energy; Energy as a property, different forms of stored energy, internal energy, first law for a non-flow process; Definition of enthalpy, C_p, C_v; Energy of an isolated system.	2
	Flow energy: First law for an open system-steady flow energy equation; Examples of steady flow devices (nozzle and diffuser, turbine, pump, compressor, heat exchanger, throttling device); PMM-I.	2

HOD, EE

	Second law of Thermodynamics: Qualitative difference between heat and work; Definition of source & sink: cyclic heat engine, heat pump and refrigerator, thermal efficiency of heat engine, C.O.P of heat pump and refrigerator; Kelvin-Plank and Clausius statements of second law; Equivalence of the two statements. PMM-II Reversible process; Irreversible process; Factors for irreversibility; Carnot cycle and Carnot efficiency; Carnot theorem, corollaries; Reversible heat engine and heat pump.	2 2
Module 2	**Entropy:** Clausius Inequality: Entropy as a property; T-s plot for reversible isothermal, adiabatic, isochoric & isobaric processes. Tds equation and calculation of entropy change of ideal gases for various processes; entropy change of solids; Concept and uses of entropy, Entropy principle. **Pure substance**: Definition, properties of pure substance; Phases of pure substance; Phase change processes of pure substances — critical point, triple point; Property (phase) diagrams — P- v, P- T, T- s, h-s diagrams; P v T surface for water; Property tables of pure substances — compressed liquid, saturated, wet and superheated vapour, use of saturated and superheated steam table and Mollier diagram **Vapour power Cycle:** Carnot cycle and its practical difficulties; Basic Rankine cycle with steam; Mean temperature of heat addition, steam rate, heat rate; Reheat cycle; Regenerative cycle , Binary vapour cycle.	2 3 7
Module 3	**Nozzles** ; Types of nozzles:Flow throigh nozzles under dry saturated and superheated condition; exit velocity calculation , condition for maximum mass flow rate through ; relationship between area, velocity ,pressure . **Turbines:** Steam turbine classification, Impulse Turbine velocity diagram, Blading efficiency, staging efficiency ,condition for maximum blading efficiency, Reaction turbine , degree of reaction , Parson's reaction Turbine, Condition for maximum blading efficiency of Parson's reaction turbine , Reheat factor, carry over efficiency,blade height calculation. **Governing** : Governing of steam turbine and Losses	3 7 2
Module 4	**Boilers:** Types of boilers ; fire tube boilers , water tube boilers, economiser, evaporator and superheater efficiency, overall efficiency of boiler , natural circulation , forced circulation , Boiler draught, Induced draught , Forced draught , Calculation of chimney height, Efficiency of chimney , Power required to drive fan , Boiler performance and testing . **Bolier: Boiler** operation and safety practices. **Condenser** : Types of condensers,vacuum efficiency , condenser efficiency, Cooling water and Cooling ponds, **Material Handling**: Coal handling and Ash handing system in thermal power plants.	7 1 2 2
		48

HOD, EE

Text Books:

1. Engineering Thermodynamics- 5e, Nag, P.K. – TMH.
2. Power Plant Engineering – P.K.Nag – McGraw Hill Education (India) Pvt. Ltd.
3. Thermal Engineering – R.K.Rajput – Laxmi Publication Pvt. Ltd.

Reference Books:

1. Thermal Engineering – Domkundwar – Dhanpat Rai & Co.

FIELD THEORY

Code: ELEC2204
Credit: 3 **Contact: 3L**

Course Outcome: After completion of the course students will be able to

CO1: Apply knowledge of different co-ordinate systems for field analysis problems.

CO2: Apply different techniques of vector calculus to analyze electromagnetic fields to reach substantiated conclusions.

CO 3: Solve static electric field problems for different engineering applications by using vector calculus.

CO4: Solve static magnetic field problems for different engineering applications by using vector calculus.

CO5: Apply the knowledge of Maxwell's equation in solving wave propagation problems.

CO6: Understand and analyze the concepts of electromagnetic waves.

Module 1: **7L**

Introduction: Curvilinear coordinate system, Cartesian coordinates, Cylindrical coordinates, Spherical coordinates & their transformation. Differential length, area and volume in different coordinate systems.

Introduction to Vector calculus: DEL operator, Gradient of a scalar, Divergence of a vector & Divergence theorem, Curl of a vector & Stoke's theorem, Laplacian operator on scalar and vector, Classification of vector fields, Statement of Helmholtz's theorem, Uniqueness theorem.

Module 2: **10L**

Coulomb's law and Electric field intensity: Coulomb's law, Electric field intensity E & Potential Φ, field due to line charge, field due to sheet charge, field due to continuous volume charge distribution.

Electric flux density and Gauss's Law: Electric flux density, Gauss's law, Maxwell's first equation, Application of Gauss's law.

Energy and potential: Relationship between E and V, Polarization and Dipole moment, Energy density in electrostatic field.

Dielectrics and Capacitance: Electric boundary conditions between dielectrics and conductor–dielectric, capacitance.

Poisson's and Laplace's equation: Poisson's and Laplace's equation, Application of Poisson's and Laplace's equation for solving Electrostatic problems.

Current and conductors: Ohm's law and law of conservation of charge and continuity equation.

Module 3: **11L**

The Steady Magnetic Field : Biot-Savart's law, Ampere's circuital law both differential and Integral form, Magnetic flux density, Magnetic field intensity, Magnetic Vector and Scalar Potential.

Magnetic materials and boundary condition: Magnetization in material and permeability, Boundary conditions between two magnetic media, Magnetic circuits.

Inductance and Energy: Self and Mutual inductance, Inductance of solenoid, Inductance of coaxial cable, Inductance of two wire transmission lines, Energy stored in magnetic field.

Magnetic Forces: Force on a moving charge and current carrying conductor due to magnetic field, Torque developed in current carrying coil in a magnetic field, magnetic moments, forces on magnetic materials.

Module 4: **8L**

Time-Varying Electromagnetic Fields and Maxwell's equation: Faraday's law, Transformer and motional emf, Displacement current, Loss tangent, Maxwell's equations for time varying fields, Time varying Potential, Time harmonic fields.

HOD, EE

Electromagnetic wave propagation: Electromagnetic wave equation in loss-less dielectric medium and conducting medium, Plane and polarized waves and their propagation, Intrinsic Impedance, solution of wave equation, Skin effect, Skin depth, Poynting's Theorem and Poynting vector, and it's application.

Text Books:

1. Engineering Electromagnetics by W.H.Hayt
2. Electromagnetics by Kraus & Carver
3. Electromagnetic Theory and application by P.Mukhopadhyay
4. Electromagnetics by A.Pramanik
5. Electromagnetics by Joseph Edminister
6. Electromagnetic fields by Griffiths.

Electrical Machine Laboratory-I

Code: ELEC 2251 **Contact Hour: 2P**
Credit: 1

Course Outcome:
Students will be able to
1. Understand the operation of DC machines by studying its characteristics.
2. Evaluate the performance of a DC machine by calculating its efficiency.
3. Apply the knowledge to correlate theory with experimental efficiency and regulation calculation in single phase transformer and learn about parallel operation in single phase transformers.
4. Learn to make several connections in a three phase transformer.

List of Experiments:

1. Study of the characteristics of a DC shunt generator.
2. Study of the characteristics of a DC compound motor.
3. Study of methods of speed control of DC shunt motor.
4. Study of the characteristics of a compound DC generator.
5. Study of the characteristics of a DC series motor.
6. Determination of efficiency of a DC machine by
   (a) Swinburne's test.
   (b) Hopkinson's test
7. Determination of efficiency and regulation of a single phase transformer by:
   (a) Open circuit and Short circuit test.
   (b) Load test.
8. Study of different connections of 3-phase transformer
9. Parallel operation of single phase transformers.

HOD, EE

SIGNALS & SYSTEMS LAB.

CODE: ELEC2252 **CONTACT: 2P**
Credit: 1

COURSE OUTCOMES

Students will be able to:

- Understand the elementary concept of various types of signal.
- Study and analyze the time domain response of various system.
- Analyze a system from its frequency response.
- Model a system in state variable approach and study the response of it.

List of Experiments:

1. The generation of different type of continuous and discrete signals using MATLAB.
2. Spectrum analysis of different signals.
3. Study of aliasing phenomenon and convolution.
4. Time response of first and second order systems for step, ramp and impulse input.
5. Study of performance indices of second order system excited by step input.
6. Frequency response of first and second order systems.
7. Determination of z- transform and inverse z transform using MATLAB.
8. Obtain Transfer Function of a given system from State Variable model and vice versa using MATLAB.
9. Obtain the step response and initial condition response of SISO and MIMO systems in SV form by simulation.

HOD, EE

BASIC THERMAL POWER ENGINEERING LAB

Code: ELEC2253 **Contacts: 2P**

Credits: 1

Expt No.	Title of the Experiment	Periods
1	Study of Two stroke petrol and Four Stroke Diesel and Petrol engines through cut models	2
2	Study of various types of water tube and Fire tube boilers through cut models	2
3	To find the calorific value od diesel fuel using Bomb Calorimeter	2
4	To find the Flash Point and Fire Point of Diesel Fuel using Pensky Marten's Apparatus.	2
5	To find the dryness fraction of steam by Separating and Throttling Calorimeter	2
6	To find the valve timing diagram of a 4 stroke petrol engine	2
7	To carry out volumetric efficiency test on 4 stroke single cylinder diesel engine.	2
8	To carry out the fuel consumption test on 4 stroke single diesel engine.	2
9	Exhaust gas emission test	2

HOD, EE

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Analog Electronic Circuits					
Course Code: AEIE2101					
Contact hours per week	L	T	P	Total	Credit points
	3	0	0	3	3

Module-I (10L)

Small signal analysis of transistor amplifier circuits with different biasing methods, operational amplifier (Op-Amp) fundamentals, Op-Amp characteristics, Op-Amp in open loop comparator mode, linear Op-Amp circuits:

Basic (inverting/ non-inverting) Op-Amp circuits, V-I converter, constant current source, level shifter, current amplifier, difference amplifier, instrumentation amplifier.

Module-II (8L)

Non-linear Op-Amp circuits: Schmitt trigger, precision rectifiers, peak detector, log/antilog amplifiers, S/H circuit. practical Op-Amp limitations: d.c. errors, slew rate, frequency response, noise effect, frequency compensation.

Active integrators, differentiators and solution of differential equations.

Module-III (9L)

Active filters: Butterworth and Chebyshev, signal generators: Colpitts, Hartley, phase shift, Wein bridge and crystal oscillators, triangular wave generator and sawtooth wave generator using op-amp.

Module-IV (8L)

Multivibrators and its applications: astable, monostable using op-amp (IC741) and integrated circuit timer 555, voltage controlled oscillator and phase locked loop.

References:

1. Sedra & Smith-*Microelectronic Circuits*- Oxford UP
2. Franco—*Design with Operational Amplifiers & Analog Integrated Circuits* , 3/e, McGraw Hill
3. Boylested & Nashelsky- *Electronic Devices and Circuit Theory*- Pearson/PHI.
4. Coughlin and Driscol – *Operational Amplifier and Linear Integrated Circuits*–Pearson Education
5. Millman & Halkias – *Integrated Electronics*, McGraw Hill.
6. Schilling & Belove—*Electronic Circuit: Discrete & Integrated* , 3/e , McGraw Hill.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Outcomes:

After completion of the course, students will be able to

1. Apply the knowledge of semiconductor fundamentals to analyze simple electronic circuits based on diodes and transistors with special focus on designing different biasing methods of BJT.
2. Design and analyze BJT amplifiers for small and large signal.
3. Learn basic function of operational amplifier, ideal and practical characteristics and their mathematical applications.
4. Design and compare between different types of Oscillators to meet the specified needs with appropriate consideration.
5. Design, analyze and understand the application of different types of multivibrators with and without IC 555.
6. Analyze and design analog electronic circuits using discrete components with specified needs for enhancement of knowledge.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Sensors and Transducers					
Course Code: AEIE2102					
Contact hours per week	L	T	P	Total	Credit points
	4	0	0	4	4

Module I – [12L]

Definition, principles of sensing and transduction, classification;

Concept of signal conditioning;

Resistive (potentiometric) sensors: theory, types, materials, specifications, error in measurements, reducing mechanism, measurement of vibration and its parameters like displacement, velocity and acceleration; Strain Gauges: theory, types, materials, sensitivity, gauge factor, temperature dependence, adhesives, rosettes, applications-force, velocity and torque measurements;

Capacitive sensors: theory, types- parallel plates, semicircular and cylindrical; calculation of sensitivities, response characteristics, microphones;

Inductive sensors: theory, types- reluctance, LVDT: Construction, materials, electromechanical relationship, phase sensitive detector.

Module II – [8L]

Piezoelectric sensors: piezoelectric effects, materials- natural and synthetic types, charge and voltage coefficients, crystal model, characteristics; Pyroelectric sensors.

Magnetic sensors: theory, types, force, torque, rpm meters;

Proximity sensors: inductive, capacitive and photoelectric;

Hall Effect and performance characteristics of Hall sensors.

Module III – [10L]

Thermal sensors: RTD- materials, construction, types, working principle, 2-wire, 3-wire and 4-wire configurations and respective circuit arrangements.

Thermistor – materials, construction, types, working principle

Thermocouple – thermoelectric laws, types, working principle, thermopile, series and parallel configuration of thermocouples, cold junction compensation, compensating and extension cables, burnout feature.

Pyrometer (total radiation and optical types)

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Module IV – [6L]

Optical sensors: light dependent resistor (LDR), photodiode, photovoltaic cell, photomultiplier tube;
Ionization sensors: construction and working principle of Geiger counters, Scintillation detectors; Introduction to Radiation sensor.
Ultrasonic sensors: working principle, industrial applications;

References:

1. D Patranabis, *Sensors and Transducers*, PHI, 2nd ed.
2. E. A. Doebelin, *Measurement Systems: Application and Design*, Mc Graw Hill, New York
3. H. K. P. Neubert, *Instrument Transducers*, Oxford University Press, London and Calcutta.
4. S. Renganathan, *Transducer engineering*, Allied Publishers Limited, 2003.
5. D. V. S. Murty, *Transducer and instrumentation*, PHI, second edition, 2008.
6. Jacob Fraden, *Handbook of Modern Sensors: Physics, Designs and applications*, Third edition, Springer International, 2010.
7. A. K. Ghosh, *Introduction to transducers*, PHI, 2015
8. J. P. Bentley, *Principle of Measurement Systems, Pearson Education, Third edition.*

Course Outcomes:

After the completion of the course, the students will be able to:

1. Acquire the knowledge of mechanical, electromechanical, thermal and magnetic sensors.
2. Explain the working principles of mechanical, electromechanical, thermal and magnetic sensors.
3. Classify sensors based on type of measurands such as strain, force, pressure, displacement, temperature, flow, etc.
4. Design the signal conditioning circuits for the sensors.
5. Justify the selection of Sensors and Transducers in the process of Measurement and instrumentation.
6. Use the sensors in various applications.

Heritage Institute of Technology

Department of Applied Electronics & Instrumentation Engineering

Course Name: Circuit Theory and Network Analysis					
Course Code: AEIE2103					
Contact hours per week	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [10L]

Analysis of DC circuits: Circuit elements and their various configurations: Passive, active, Analysis tools: Analysis of resistive circuits with and without controlled sources using mesh, node analysis, Concepts on super mesh and super node, DC network theorems: Superposition, Thevenin, Norton, Millman and Maximum Power Transfer Theorem.

Module II – [10L]

Analysis of AC circuits: Representing circuit elements in AC circuits, concept of phasors, Parameters in the AC circuits: Average, RMS, Form factor, peak factor; Tools of analysis of AC circuits: mesh, nodal tools; Network theorems: Superposition, Thevenin, Norton, Millman, Power and Maximum Power Transfer Theorem.

Resonance circuits: Series and parallel, condition of resonance, impedance curve, current curve, half power points, bandwidth, quality factor, selectivity, application to different combination of parallel circuits, Analysis of magnetically coupled circuits: Self and mutual inductances, coefficient of coupling, dot convention.

Module III – [10L]

Two Port Network: open circuit, short circuit, transmission and hybrid parameters, relationships among parameters, reciprocity and symmetry conditions. T and Pi representations of 2-port networks;

Interconnection of networks: Series, parallel and cascade connections.

Transient analysis: Time domain analysis of R-L and R-C circuits- time constant, initial and final values, transient and steady state responses;

Time domain analysis of RLC circuits: Transient and steady state responses, effect of damping;

Module IV – [6L]

Basic filter circuit Design & Synthesis: Classifications, ideal and practical characteristics of filters, cutoff frequency, bandwidth, quality factor, Butterworth filter 2nd, 3rd and 4th order design (RC).

References:

1. Franklin F Kuo, *Network Analysis and Synthesis,* Wiley India Edition.
2. M E Van Valkenburg, *Network Analysis"*. Prentice-Hall of India Pvt Ltd, New Delhi.
3. K V V Murty and M S Kamth, *Basic Circuit Analysis,* Jaico Publishing house, London.
4. Reinhold Lud0wig and Pavel Bretchko, *RF Circuit Design*, Pearson Education, Asia.
5. Joseph J. Carr, *Secrets of RF Circuit Design*, Tata McGraw-Hill, New Delhi.
6. William H. Hayt, Jack E. Kemmerly, *Engineering Circuit Analysis*, McGraw-Hill Higher Education.
7. K.M.Soni, *Circuit Analysis & Synthesis*, S. K. Kataria & Sons.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Apply knowledge of mathematics, science, and engineering to the analysis and design of electrical circuits.
2. Identify, formulate, and solve engineering problems in the area circuits and systems.
3. Acquire skills in analyzing electrical measuring devices, analog electronic circuits, and power electronic circuits.
4. Analyze and synthesize RL, RC and RLC networks, passive and active filters.
5. Obtain circuit matrices of linear graphs and analyze networks using graph theory.
6. Design an electric system, components or process to meet desired needs within realistic constraints.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering
Honours Course:

Course Name: Material Science and Technology					
Course Code: AEIE2111					
Contact hrs per week:	L	T	P	Total	Credit points
	4	0	0	4	4

Module I: [12L]

Introduction, properties of materials, classification of materials, advanced materials, future materials and modern materials. 3L

Atomic structure, atomic bonding in solids, crystal structures, crystalline and non-crystalline materials, Miller indices, anisotropic elasticity, elastic behavior of composites, structure and properties of polymers, structure and properties of ceramics. 5L

Electrical conduction, semi conductivity, super conductivity, electrical conduction in ionic ceramics and in polymers, dielectric behavior, ferroelectricity, piezoelectricity. 1L

Heat capacity, thermal expansion, thermal conductivity, thermal stresses. 1L

Diamagnetism and paramagnetism, ferromagnetism, anti-ferromagnetism and ferrimagnetism. Influence of temperature on magnetic behavior. 1L

Optical properties of metals, optical properties of nonmetals, application of optical phenomena. 1L

Module II: [10L]

Point defects, theoretical yield point, line defects and dislocations, interfacial defects, bulk or volume defects. 2L

Elastic deformation, plastic deformation, interpretation of tensile stress-strain curves yielding under multi-axial stress, yield criteria and macroscopic aspects of plastic deformation, property variability and design factors. 3L

Diffusion mechanisms, steady and non-steady state diffusion, factors that influence diffusion, non-equilibrium transformation and microstructure. 2L

Dislocation and plastic deformation, mechanisms of strengthening in metals, recovery, re-crystallization and grain growth, strengthening by second phase particles, optimum distribution of particles, lattice resistance to dislocation motion. 3L

Module III: [9L]

Equilibrium phase diagrams, particle strengthening by precipitation, precipitation reactions, kinetics of nucleation and growth, the iron-carbon system, phase transformations, transformation rate effects and TTT diagrams, microstructure and property changes in iron-carbon system. 4L

Fracture, ductile and brittle fracture, fracture mechanics, impact fracture, ductile brittle transition, fatigue, crack initiation and propagation, crack propagation rate, creep, generalized creep behavior, stress and temperature effects. 5L

Module IV: [9L]

Types of metals and alloys, fabrication of metals, thermal processing of metals, heat treatment, precipitation hardening. 2L

Types and applications of ceramics, fabrication and processing of ceramics. 1L

Mechanical behavior of polymers, mechanisms of deformation and strengthening of polymers, crystallization, melting & glass transition, polymer types, polymer synthesis & processing. 2L

Particle reinforced composites, fiber reinforced composites, structural composites. 1L

Corrosion of metals, corrosion of ceramics, degradation of polymers. 1L

Economic considerations, environmental and societal considerations, recycling issues, life cycle analysis and its use in design. 2L

References:

1. Material Science and Engineering by V. Raghavan, Prentice Hall.

2. Introduction to Engineering Materials by B. K. Agarwal, TMH.

3. Elements of Material Science & Engineering, Van Black, Pearson Education

4. Materials Science and Engineering by W. F. Smith, J. Hashemi and R. Prakash, McGraw Hill.

5. A Textbook of Material Science and Engineering by R.K.Rajput, S.K.Kataria & Sons.

6. Materials Science and Engineering by W. D. Callister and adapted by R. Balasubraniam, Wiley India.

Course Outcomes:

After the completion of the course the student will be able to:

1. Explain the properties and structure of engineering materials.
2. Analyze defects in materials and their effect on engineering properties as well as limit their use in service.
3. Make use of phase diagrams to predict microstructures and also to understand precipitation hardening.
4. Compare & Evaluate the processing of engineering materials.
5. Choose the proper engineering material for defined field of applications with economic, environmental and societal considerations.
6. Determine the importance of material properties in engineering design.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Analog Electronics Lab					
Course Code: AEIE2151					
Contact hours per week	L	T	P	Total	Credit points
	0	0	3	3	1.5

List of experiments:

1. Study the frequency response of a single-stage and a two-stage R-C coupled amplifier.
2. Design a series-regulated power supply to provide output voltage of 5-25V with load current I_L< 1Amp and verify the design using PSpice.
3. Implementation of zero crossing detector using operational amplifier.
4. Implementation of level shifter circuit using operational amplifier.
5. Study of half wave and full wave precision rectifiers and verify the design using PSpice.
6. Study of Multivibrators (Astable/ Monostable) using op-amps.
7. Study of Multivibrators (Astable/ Monostable) using IC 555.
8. Design of an oscillator circuit (Wien bridge).
9. Design of signal generator (Triangular wave/ Sawtooth wave) using IC741.

References:

1. Sedra & Smith-*Microelectronic Circuits*- Oxford UP
2. Boylested & Nashelsky- *Electronic Devices and Circuit Theory*- Pearson/PHI
3. Coughlin and Driscol – *Operational Amplifier and Linear Integrated Circuits*–Pearson Education
4. Schilling & Belove—*Electronic Circuit: Discrete & Integrated*, 3/e , McGraw Hill.

Course Outcomes:

After completion of the course, students will be able to

1. Identify different components of electronic circuits.
2. Evaluate the performance characteristics of electronic circuits.
3. Design different kind of electronic circuits appropriately to obtain the best possible circuits that can be applied to any electronic systems.
4. Evaluate possible causes of discrepancies in practical experimental observations in comparison to theory.
5. Practice different types of wiring and instruments connections for efficient operation.
6. Evaluate the use of computer-based analysis tool to review the performance of electronic circuit.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Sensors and Transducers Lab					
Course Code: AEIE 2152					
Contact hrs per week:	L	T	P	Total	Credit Points
	0	0	2	2	1

List of Experiments:

1. Comparative studies of some temperature measuring sensors like AD590 IC sensor, RTD and thermistor.
2. Study of capacitive transducer.
3. Study of I/O characteristics of LVDT and hence measure pressure & displacement through it.
4. Study of a load cell with tensile and compressive load.
5. Rotational speed measurement using magnetic proximity sensor
6. Measurement of rotational speed measurement using stroboscopic principle
7. Comparative studies of some optical sensors like LDR, photo diode and photo transistor
8. Design of a suitable signal conditioning circuit for a given sensor

Course Outcome:

After completion of the course, students will be able to

1. Compare various temperature sensors and select the best-fit sensor for a specific application.
2. Choose different transduction techniques for measuring linear and angular displacements.
3. Demonstrate various pressure and stress sensing elements.
4. Measure rotational speeds using non contact type various principles like proximity and stroboscopic principles
5. Select different application based optical sensors.
6. Design sensing system based signal-conditioning circuits.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Circuits and Networks Lab					
Course Code: AEIE 2153					
Contact hrs per week:	L	T	P	Total	Credit Points
	0	0	2	2	1

A. **Hardware Based Experiments:**

1. Verification of Thevenin's and Norton's theorems
2. Verification of Superposition Theorem
3. Transient response in RC, RL & RLC networks
4. Frequency response of passive and active (LP, HP, BP, BR) filters of 1st & 2nd order

B. **Software Based Experiments:**

1. **PSPICE Based:**
   i. Transient analysis of RC and RL circuits
   ii. Leading and lagging analysis for RC and RL circuits
   iii. Over damped, under damped, critically damped analysis of a 2nd order system by appling different inputs
   iv. Frequency response of 2nd order system

2. **MATLAB Based:**
   i. Different types of signal generation
   ii. Laplace and inverse Laplace transforms

Course outcomes:

After completing the course, the students will be able to

1. Use basic laboratory equipments such as multimeters, power supplies, signal generators, and oscilloscopes and techniques to measure electrical quantities
2. Apply analysis tools, theorems to analyze the experimental result.
3. Analyze RL, RC, RLC circuits in time and frequency domains.
4. Carry out time & frequency domain measurements on elementary RL, RC, RLC circuits using PSPICE simulation software.
5. Develop technical writing skills important for effective communication
6. Acquire teamwork skills for working effectively in group

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Digital Electronics					
Course Code: AEIE2201					
Contact hours per week	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I - [9L]

Data and number systems: binary, octal and hexadecimal representation and their conversions, BCD,ASCII, Gray codes and their conversions; signed binary number representation with 1's and 2's complement methods, binary arithmetic. Boolean algebra: various logic gates- their truth tables and circuits, combinational logic design: Definition, truth table, SOP and POS realization from truth table, logic minimization using K-map, minterms and maxterms, minimization with don't care terms.

Module II - [8L]

Combinational circuits: adder / subtractor circuits; parity generator/checker circuit, binary to Gray and Gray to binary conversion circuits, encoder, decoder, demultiplexer and multiplexer, function realization using decoder and multiplexer.

Module III - [9L]

Sequential Circuits: basic concepts, flip-flop, RS, JK, Master Slave, T and D flip-flops, shift registers and their applications, synchronous and asynchronous counters, up/down counters, ring counter.

Module IV - [9L]

Characteristics of Aanalog to digital and digital to analog converters: resolution, quantization, significant bits, conversion/settling time, types of analog to digital converters: successive approximation, integrating, flash and sigma-delta, types of digital to analog converters: weighted R, R-2R ladder. Introduction to various logic families: TTL, ECL, and CMOS, programmable logic devices – PROM, PLA, and PAL.

References:

1. Malvino & Brown, *Digital Computer Electronics*, TMH
2. H. Taub & D. Shilling, *Digital Integrated Electronics*, Mc Graw Hill
3. M. Mano, *Digital Logic and Design*, PHI
4. A. Anand Kumar, *Fundamentals of Digital Circuits*, PHI
5. Kharate, *Digital Electronics*, Oxford
6. Floyed & Jain, *Digital Fundamentals*, Pearson.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course outcomes:

After completion of the course, the students will be able to

1. Understand the fundamentals of converting from one number system to another.
2. Explain the basic logic operations of NOT, AND, OR, NAND, NOR, and XOR.
3. Analyze, design and implement combinational logic circuits.
4. Analyze, design and implement sequential logic circuits.
5. Describe the nomenclature and technology in the area of memory devices: ROM, PROM, PLD etc. and different kind of ADCs and DACs.
6. Understand the basic operating principles of different logic families.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Paper Name: Industrial Instrumentation					
Paper Code: AEIE2202					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

Module I [10L]

Pressure: unit, absolute, gauge and vacuum pressures; manometers – u-tube, inclined tube and well type; elastic pressure sensing instruments – diaphragm, capsule, bellows, Bourdon tube pressure gauge, and pressure switch; DP transmitters: capacitive, piezo - resistive and resonating wire type, installation of DP measuring instruments and valve manifolds; flapper nozzle system & basic operation, pneumatic transmitter; vacuum: Mcleod gauge, thermal conductivity gauge and ionization gauge.

Module II [10L]

Variable head type flow measurement – orifice, venturi, pitot tube, analysis and calculation; variable area flowmeters – glass and metal tube rotameters; electromagnetic type; ultrasonic type; vortex type; positive displacement type; Coriolis mass flow meters; impeller type mass flow meters; open channel flow metering; solid flow measurement.

Module III [9L]

Level measurement: gauge glass, float, displacer type – gauge and switch;
resistive and capacitive type level instrument; boiler drum level measurement; ultrasonic, radioactive type and radar type level instrument; solid level measurement

Module IV [7L]

Analytical measurements: pH, conductivity, viscosity, density, humidity and moisture
Hazardous area instrumentation: basic concepts, classification- intrinsically safe and explosion proof, NEMA and IP codes, intrinsically safe measurement system.

References:

1. B. G. Liptak, *Instrument Engineers Handbook, vol-I and vol-II*; Chilton Book Co. Philadelphia.
2. Eckman, *Industrial Instrumentation*; Wiley Eastern Ltd.
3. D. M. Considine and G. D. Considine (Eds.) *Process Instruments and controls Handbook*; Mc Graw Hill, New York.
4. D. Patranabis, *Principles of industrial Instrumentation*; TMH, New Delhi, 2nd Ed.
5. Ernest O. Doeblin, *Measurement Systems – Application and Design*; Tata-McGraw Hill.
6. K. Krishnaswamy, *Industrial Instrumentation*; New Age International.
7. S. K. Singh, *Industrial Instrumentation & Control*; Tata McGraw-Hill.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Outcome:

After the completion of the course students will be able to

1. Explain the working principles of pressure measuring devices and apply acquired knowledge for selection and installation of application specific pressure sensing instruments.
2. Interpret the working principles, selection criteria and installations of application specific industrial flow measuring instruments
3. Demonstrate different level measuring devices and apply the knowledge towards the choice of proper sensing industrial instruments.
4. Illustrate various analytical instruments to measure pH, conductivity, moisture, humidity etc. and hazardous area instrumentation.
5. Formulate industrial process parameters towards the analysis of process data
6. Design electronic instrumentation system for the acquisition of measurement data produced by measuring instruments for flow, level, and pressure

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Electrical and Electronic Measurements						
Course Code: AEIE2203						
Contact hrs per week:	L	T	P	S	Total	Credit points
	4	0	0	0	4	4

Module I – [11L]

Static and dynamic characteristics of instruments: accuracy, sensitivity, repeatability, precision, drift, hysteresis, threshold, resolution, fidelity, speed of response.

Classification of analog instruments, types of torques in indicating instruments, construction and principle of operation of permanent magnet moving coil, moving iron, dynamometer and electrostatic type instruments, extension of instrument ranges using shunts and multipliers.

Introduction to instrument transformers: current transformer and potential transformer.

Measurement of energy by single phase induction type meter.

Module II – [9L]

Measurement of medium resistance: ammeter-voltmeter methods, substitution method, Wheatstone bridge method; measurement of low resistance by Kelvin double bridge; 4-terminal resistance.

Measurement of high resistance: direct deflection method, loss of charge method, megger ;

Measurement of self inductance: Maxwell's inductance bridge, Maxwell's inductance-capacitance bridge, Anderson's bridge; Measurement of capacitance: DeSauty's bridge, Schering bridge; Measurement of frequency by Wien's bridge.

Localization of cable faults using Murray and Varley loop methods.

Module III – [10L]

Voltage controlled oscillator, phase locked loop, applications; basic emitter follower voltmeter, DC and AC voltmeters with operational amplifiers, true rms voltmeter, chopper stabilized amplifiers for measurement of very low voltage.

Cathode ray oscilloscope: cathode ray tube, sweep generator, oscilloscope automatic time base, waveform display, dual-trace oscilloscopes, oscilloscope probes, applications.

Module IV – [10L]

Digital voltmeters: characteristics, types- ramp type, dual slope integrating type, successive approximation type, microprocessor based ramp type; basic digital displays, LEDs and LCD panels, display drivers; time base generation with crystal oscillators and dividers.

Design and implementation of a simple digital frequency meter, errors in frequency measurement – possible remedies, pulse time period and width measurement, frequency ratio measurement.

Q meter: basic circuit, series connection method, parallel connection method, sources of errors.

References:

1. Golding & Widdis, Electrical Measurements & Measuring Instruments ; Wheeler
2. Forest K. Harris, Electrical Measurement; Willey Eastern Pvt. Ltd. India
3. M.B. Stout, Basic Electrical Measurement; Prentice Hall of India
4. David Bell, Electronic Instrumentation & Measurement; Reston Publishers.
5. H.S. Kalsi, Electronic Instrumentation; Tata McGraw Hill.
6. A.D. Helfrick & W.D. Cooper , Modern Electronic Instrumentation & Measuring Instruments; Wheeler
7. D.C. Patranabis, Principles of Electronic Instrumentation; PHI

Course Outcomes:

After the completion of this course students will be able to:

1. Interpret the static and dynamic characteristics of measuring instruments.
2. Compare among the operation of measuring instruments and select the suitable one for measurement of electrical quantities.
3. Choose appropriate bridge for measurement of resistance, capacitance and inductance.
4. Select electronic voltmeters suitable for typical measurements and explain the construction of cathode ray tube, circuits of oscilloscope time base, CRO probes , dual trace oscilloscope and applications.
5. Analyze the working of different types of digital voltmeters, digital frequency meter and digital display units.
6. Determine the quality of a coil, capacitor using Q meter.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Control Systems						
Course Code: AEIE2204						
Contact hrs per week:	L	T	P	S	Total	Credit points
	3	1	0	0	4	4

Module-I-[10L]

Introduction- application of control theory in engineering and non-engineering fields, mathematical model of physical systems- importance, differential equation representation of physical systems, transfer function models, block diagram models, signal flow graphs models, reduction of parameter variations by use of feedback.

Control system components- DC servomotor, Brushless DC motor, AC servomotor, synchro, stepper motor.

Module-II-[10L]

Time domain analysis - transient response of first order and second order with standard test signals, steady state error coefficients, effect of pole–zero addition in system response, design specifications of second order systems, performance indices.

Stability analysis - concept of stability, necessary and sufficient condition for stability, Routh stability criterion, concept of relative stability; root locus technique - the root locus concept, root locus construction rules, stability analysis from the root locus plot.

Module- III-[10L]

Frequency domain analysis techniques – correlation between time and frequency response; Polar plots, Nyquist plots- mapping of close contour and principle of arguments, development of Nyquist stability criterion; Bode plots - minimum and non minimum phase system, concept of phase margin and gain margin, procedure for drawing Bode plots, assessment of relative stability–gain margin and phase margin.

Module –IV-[10L]

State space analysis - concepts of state, state variables and state model, state space representation of linear continuous-time systems, solution of linear time invariant state equation, concept on controllability and observability, illustrative examples.

Basic compensation techniques- the design problems, lead compensation, lag compensation and lag-lead compensation.

Reference

1. Nagrath I. J. and Gopal M., "Control System Engineering", 5th Ed., New Age International Private Ltd. Publishers.
2. Kuo B. C., "Automatic Control Systems", 8th Ed., Wiley India
3. Ogata K., "Modern Control Engineering", 4th Ed., Pearson Education.
4. Dorf R. C. and Bishop R. H., "Modern Control Systems" Pearson Education.
5. Norman S. N., "Control Systems Engineering", 4th Ed., Wiley India.
6. Gopal M., "Control Systems principles and Design", Tata McGraw Hill

Course Outcomes:

After the completion of this course students will be able to:

1. Develop mathematical model of physical systems in forms of differential equation and transfer function.
2. Represent the systems using block diagram and signal flow graph models.
3. Investigate the time response of systems and calculate performance indices.
4. Apply the concept of stability in s-domain by using Routh stability criterion and root locus technique.
5. Analyze frequency response and stability of linear systems using different stability criterion.
6. Understand the concept of state variable analysis and compensation techniques for design.

Course Name: Mathematics-III Algebraic Structures					
Course Code: MATH2201					
Contact Hours per week:	L	T	P	Total	Credit points
	4	0	0	4	4

1. Course Outcomes

After completion of the course, students will be able to:

MATH2211.1. Describe the basic foundation of computer related concepts like sets, Posets, lattice and Boolean Algebra.

MATH2212.1. Analyse sets with binary operations and identify their structures of algebraic nature such as groups, rings and fields.

MATH2213.1. Give examples of groups, rings, subgroups, cyclic groups, homomorphism and isomorphism, integral domains, skew-fields and fields.

MATH2214.1. Compare even permutations and odd permutations, abelian and non-abelian groups, normal and non-normal subgroups and units and zero divisors in rings.

MATH2215.1. Adapt algebraic thinking to design programming languages.

MATH2216.1. Identify the application of finite group theory in cryptography and coding theory.

2. Detailed Syllabus

Module 1 [10L]

Sets, Relations and Functions: Basic operations on sets, Venn diagrams. Binary relations defined on sets, equivalence relations and equivalence classes, order, relation and lattices, partially ordered sets, Hasse diagrams, maximal, minimal, greatest and least elements in a partially ordered set, lattices and their properties, principle of duality, distributive and complemented lattices.

Module 2 [10L]

Group Theory I: Cartesian product, Binary operation, Composition Table. Group, Elementary theorems on groups, Quasi-group and Klein's 4 group. Permutations, Product of permutations, Group property of permutations, Cyclic permutation, Transposition, Even and Odd permutations, Proposition regarding permutations, Alternating Groups.

Module 3 [10L]

Group Theory II: Order of an element of a group, Properties of the order of an element of a group , Subgroups, some basic theorems on subgroups, Cyclic group, Cosets, Lagrange's theorem, Fermat's Little Theorem(statement only). Normal subgroup, some basic theorems on Normal subgroup.

Module 4 [6L]

Morphisms, Rings and Fields: Homomorphism and Isomorphism of groups, some basic theorems. Rings, some elementary properties of a ring, Ring with unity, Characteristic of a ring, Ring with zero divisors, Sub-ring, Integral domain, Field, Division Ring or Skew Field. (Emphasis should be given on examples and elementary properties).

3. Textbooks

1. Higher Algebra, S.K.Mapa, Sarat Book Distributors.
2. Advanced Higher Algebra, J.G.Chakravorty and P.R.Ghosh, U.N. Dhur and Sons.

4. Reference Books

1. A First course in Abstract Algebra, J.B.Fraleigh, Narosa.
2. Algebra, M. Artin, Pearson.

Course Name: Microprocessors & Microcontrollers					
Course Code: AEIE2205					
Contact Hours per week:	L	T	P	Total	Credit points
	2	0	0	2	2

1. Course Outcomes

After completion of the course, students will be able to:

AEIE1215.2. Understand the architecture of 8-bit microprocessor (8085A).

AEIE2215.2. Develop the skill in program writing of 8-bit microprocessor (8085A).

AEIE3215.2. Understand the architecture and develop the skill in program writing of 16-bit microprocessor (8086).

AEIE4215.2. Understand the architecture and develop the skill in program writing of microprocessor 8051 and PIC16F877.

AEIE5215.2. Understand the architecture and operation of programmable peripheral device 8255A.

2. Detailed Syllabus

Module 1 [6L]

Introduction to 8-bit microprocessor: 8085 microprocessor internal architecture, 8085 pin configuration, Software instruction set, timing diagram of the instructions.

Module 2 [7L]

Addressing modes and Assembly language programming: Interrupts of 8085 processor: classification of interrupts, Programming using interrupts. Counter and Time delay, Support IC chips 8255- Block diagram, pin configuration, mode of operation, control word(s) format and Interfacing with Microprocessors.

Module 3 [7L]

Introduction to 8086/8088 Architecture: Architecture, memory segmentation, pin configuration, clock generator, instruction set, addressing modes and assembly language programming of 8086/8088, interrupts.

Module 4 [6L]

Introduction to microcontrollers: Intel MCS-51 family features, 8051 architecture, pin configuration, I/O ports and memory organization; Instruction set and basic assembly language programming, interrupts and returns; Interrupts, timer/counter and serial communication.

Brief introduction to PIC microcontroller (16F877): Architecture, pin details, memory layout etc.

3. Textbooks

1. Microprocessor architecture, programming and applications with 8085/8085A, Ramesh S. Gaonkar, Wiley eastern Ltd.
2. Fundamental of Microprocessor and Microcontrollers, B. Ram, Dhanpat Rai Publications.
3. Microprocessors and Microcontrollers, N. Senthil Kumar, M. Saravanan, S. Jeevanathan, Oxford Publications.
4. 8085 Microprocessor and its Applications, A. Nagoor Kani, Third Edition, TMH Education Pvt. Ltd.

4. Reference Books

1. The 8051 Microcontroller and Embedded. Systems. Using Assembly and C. Muhammad Ali Mazidi, Janice Gillispie Mazidi. Rolin D. McKinlay, Second Edition, Pearson Publication.
2. Advanced Microprocessors and Peripherals, A.K.Ray, K.Bhurchandi, TMH Education Pvt. Ltd.
3. PIC Microcontroller and Embedded. Systems. Using Assembly and C. Muhammad Ali Mazidi, Janice Gillispie Mazidi. Rolin D. McKinlay, Pearson Publication.
4. Design with PIC Microcontroller, John Peatman, Pearson Publication.

Course Name: Environmental Sciences (Mandatory)					
Course Code: EVSC2016					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**0**

1. Course Outcomes

After completion of the course, students will be able to:

EVSC2116.1. Understand the natural environment and its relationships with human activities.
EVSC2126.1. Characterize and analyze human impacts on the environment.
EVSC2136.1. Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
EVSC2146.1. Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.
EVSC2156.1. Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.
EVSC2166.1. Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

2. Detailed Syllabus

Module 1 [6L]

Socio Environmental Impact: Basic ideas of environment and its component
Population growth: exponential and logistic; resources; sustainable development.
Concept of green chemistry: green catalyst, green solvents
Environmental disaster and social issue: environmental impact assessment, environmental audit, environmental laws and protection act of India.

Module 2 [6L]

Heritage Institute of Technology

Department of Applied Electronics & Instrumentation Engineering

Course Name: Digital Electronics Lab					
Course Code: AEIE2251					
Contact hours per week	L	T	P	Total	Credit points
	0	0	2	2	1

List of Experiments:

Design and Implementation of:

1. Basic gates using Universal logic gates.
2. Adder/ Subtractor.
3. Binary to Gray and Gray to Binary Code Converters.
4. Simple Decoder & Multiplexer circuits using logic gates.
5. 4-bit parity generator & checker circuits.
6. RS, JK, D, and T flip-flops using Universal logic gates/ Pspice.
7. Synchronous Up/Down counter using flip-flops / Pspice.
8. Asynchronous Up/Down counter using flip-flops/ Pspice.
9. Shift register (Right and Left) using flip-flops.
10. Ring counter and Johnson's counter.

References:

1. Malvino & Brown, *Digital Computer Electronics*, TMH
2. M. Mano, *Digital Logic and Design*, PHI
3. Floyed & Jain, *Digital Fundamentals*, Pearson.

Course outcomes:

After completion of the course, the students will be able to

1. Analyze and identify different components of digital electronic circuits.
2. Set up testing strategies and select proper instruments to evaluate the performance characteristics of digital electronic circuits.
3. Evaluate the use of computer-based analysis tool to review the performance of digita electronic circuit.
4. Analyze, design and implement combinational logic circuits.
5. Analyze, design and implement sequential logic circuits.
6. Develop necessary digital logic and apply it to solve real life problems keeping in mind technical, economical, safety issues.

Mhali

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Paper Name: Industrial Instrumentation Lab					
Paper Code: AEIE2252					
Contact hrs per week:	L	T	P	Total	Credit Points
	0	0	2	2	1

List of Experiments:

1. Familiarization of/with diaphragm, capsule, bellow, Bourdon tube, orifice plate, pitot tube, etc.
2. Calibration of pressure gauges using dead weight tester.
3. Study the characteristics of thermocouple.
4. Study the characteristics of RTD.
5. Fluid flow rate measurement using orifice meter.
6. Measurement of fluid flow rate using rotameter.
7. Level measurement using capacitive/ultrasonic type level transducer.
8. Moisture measurement using moisture analyzer.
9. Measurement of kinematic viscosity using Ostwald viscometer.

Course Outcome:

After the completion of the course students will be able to

1. Build a knowledge selecting particular sensing elements for the measurement of physical parameters.
2. Demonstrate the calibration process of pressure measuring devices using dead weight taster.
3. Measure process parameters like flow and level using different measuring devices.
4. Select particular temperature sensing elements for the measurement of temperature.
5. Determine the measurement of viscosityofa specific solution.
6. Formulate moisture percentage of a given sample.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Electrical and Electronic Measurements Lab					
Course Code: AEIE2253					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

List of Experiments:

1. Calibration of Single Phase A.C. Energy Meter.
2. Measurement of Power using Instrument Transformer.
2. Measurement of low resistance using Kelvin's Double Bridge.
4. Measurement of Inductance by Anderson's Bridge.
5. Study of static characteristics of a measuring instrument.
6. Study of dynamic characteristics of a measuring instrument.
7. Realization of data acquisition system.
8. Study of VCO (voltage controlled oscillator) and PLL (phase locked loop).
9. Study of analog to digital converter and digital to analog converter.

Course Outcomes:

After the completion of this course students will be able to

1. Measure electrical energy and power using single phase ac energy meter and instrument transformer respectively.

2. Choose appropriate bridge for measurement of impedance.

3. Examine static and dynamic characteristics of measuring instrument.

4. Design data acquisition system to gather real time data coming from transducer.

5. Explain the working of voltage controlled oscillator and phase locked loop.

6. Develop analog to digital and digital to analog converter.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: Control Systems Lab					
Course Code: AEIE2254					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	2	2	1

List of Experiments:

1. Familiarization with MATLAB /OCTAVE control system toolbox.

2. Block diagram reduction techniques using MATLAB/ OCTAVE.

3. Transient response of first order and second order system with standard test signals, and study of system parameter using MATLAB/ OCTAVE.

4. Design and study of the response of first and second order electrical circuits using RC and RLC circuits in simulation /hardware.

5. Study of system stability by Root-locus, Bode plot and Nyquist plot using MATLAB/ OCTAVE toolbox for any given transfer function with P-Z mapping.

6. Familiarization with state space representation of models using MATLAB/ OCTAVE toolbox.

7. Study the effect of P, I, D actions on first order / second order simulated processes.

8. Study of Position and speed control of DC servo motor.

Course Outcomes:

After the completion of this course students will be able to:

1. Understand the concept of pole-zero and transfer function.
2. Derive the overall transfer function from block diagram.
3. Analyze the time response of first order and second order system for different standard input signals and calculate the transient response parameters.
4. Check the stability of a system using root locus method.
5. Find the frequency response of a system using Bode plot and Nyquist plot method.
6. Control the speed of dc motor using different controllers.

Course Name: Operating Systems Lab					
Course Code: CSEN2253					
Contact Hours per week:	L	T	P	Total	Credit points
	0	0	3	3	1.5

1. Course Outcomes

After completion of the course, students will be able to:

CSEN2253.1. Understand and implement basic services and functionalities of the operating system using system calls.
CSEN2253.2. Will be able to describe and create user defined processes.
CSEN2253.3. Understand the benefits of thread over process and implement them.
CSEN2253.4. Synchronization programs using multithreading concepts.
CSEN2253.5. Use modern operating system calls and synchronization libraries in software to implement process synchronization.
CSEN2253.6. Implementation of Inter-process communication using PIPE.

2. Detailed Syllabus

1. **Shell programming:** Creating a script, making a script executable, shell syntax (variables, Conditions, control structures, functions and commands).
2. **Process:** starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
3. **Signal:** signal handling, sending signals, signal interface, signal sets.
4. **Semaphore:** programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).
5. **POSIX Threads:** programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)
6. **Inter-process communication:** pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO).

3. Textbooks

1. Your Unix The Ultimate Guide, Sumitabha Das, MH

4. Reference Books

1. Beginning Linux Programming, Neil Matthew, Richard Stones, Wrox.

Course Name: Microprocessors & Microcontroller Lab					
Course Code: AEIE2255					
Contact Hours per week:	L	T	P	Total	Credit points
	0	0	2	2	1

1. Course Outcomes

After completion of the course, students will be able to:

AEIE1255.2. Understand and apply different instructions of 8085 microprocessor.
AEIE2255.2. Understand and apply different instructions of 8086 microprocessor.
AEIE3255.2. Understand and apply different instructions of 8051 microcontroller.
AEIE4255.2. Interface 8085A microprocessor with different input and output devices (e.g., LEDs, seven segments displays ADC, DAC, and stepper motor etc.).
AEIE5255.2. Interface 8086A microprocessor/ 8051 microcontroller with different input and output devices (e.g., LEDs, seven segments displays ADC, DAC, and stepper motor etc).

2. Detailed Syllabus

1. Familiarization with 8085A trainer kit components with the process of storing and viewing the contents of memory as well as registers. Repeat the above all using 8085A Simulator.
2. Study of programs using basic instruction set (data transfer, load/store, arithmetic, logical) of 8085A microprocessor.
3. Programming using 8085A trainer kit/simulator for:
   a) Copying and Shifting block of memory
   b) Packing and unpacking of BCD numbers
   c) Addition/Subtraction of two 8-bit Hex numbers
   d) Addition of 16-bit Hex numbers
   e) BCD Addition
   f) Binary to ASCII conversion

g) String Matching and Sorting.

4. Familiarization of 8086 microprocessor trainer kit/simulator using data transfer, load/store, arithmetic and logical instructions.
5. Write assembly language programs (ALP) using 8086 microprocessor trainer kit /simulator on the following:
   a) Finding the largest/ smallest number from an array
   b) Arranging numbers in ascending/descending order
   c) Shifting a block of data from one memory location to another
   d) Addition of a series of BCD numbers
   e) String matching
6. Interfacing of 8085A through 8255A PPI/ 8051 Microcontroller with switches and LEDs to perform
   a) Display operation
   b) Blinking operation and
   c) Scrolling operation
7. Interfacing with seven segment displays through 8-bit latch (e.g., 74LS373) using- a) 8085A trainer kit, b) 8086A trainer kit through 8255A PPI.
8. Interfacing of ADC, DAC, and Stepper motor with 8085A/8086 microprocessor trainer kit.

Dr. Subhashis Majumder
Professor and HOD
Computer Science and Engineering

3. Textbooks and References

Assignment Sets to be provided.

Course Name: FUNDAMENTALS OF STRENGTH OF MATERIALS					
Course Code: CIVL 2101					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Objective:

The course will assist the students to:

1. Provide the basic concepts and principles of strength of materials.
2. Give an ability to calculate stresses and deformations of objects under external loadings.
3. Provide the guidelines to calculate the member forces in truss structures.
4. Give an ability to apply the knowledge of strength of materials on engineering applications and design problems.

Module I [8L]

i. Concept of different types of applied and reaction forces; Free body concept and diagram; Concept and equilibrium of forces in two dimensions; Equations of equilibrium; Equilibrium of three concurrent forces — Lami's theorem.
ii. Centre of gravity; Centre of mass & centroid; Centroid of various shapes.
iii. Area moment of inertia: Moment of inertia of a plane figure; Polar moment of inertia of a plane figure; Parallel axes theorem.
iv. Concept of simple stress and strain; concept of salient points in the stress- strain diagram of ductile and brittle material; Modulus of elasticity. Relation between different Elastic moduli, Composite section, thermal stress.

Module II [14L]

i. Principal stresses, principal plane, and Mohr's circle.
ii. Hoop and meridonial stresses in thin cylindrical, conical and spherical shells.
iii. Shear force and bending moment diagrams for statically determinate beams subjected to concentrated, uniformly distributed, and linearly varying loads, relationship between loads, shear force and bending moment.

Module III [8L]

i. Bending of beams, elastic flexure formulae, Bending and shear stress, shear centre and shear flow.
ii. Analysis of determinate two dimensional trusses.
iii. Torsion in circular solid and hollow shafts.

Module IV [14L]

i. Slope and deflection analysis of determinate beams using Double integration method, Area-Moment theorem and Conjugate beam theory.
ii. Strain energy: Strain energy and complementary strain energy, Strain energy due to axial load, bending and shear.
iii. Columns: Fundamentals, criteria for stability in equilibrium, column buckling theory, Euler's load for columns with different end conditions – limitations and problems, eccentric load and secant formula.

Reference books

Sl. No.	Name of the book	Name of Author/Authors	Publisher
1	Elements of Strength of Material	S. P. Timoshenko and D. H. Young	EWP Pvt. Ltd
2	Engineering Mechanics of Solids	E. P. Popov	Pearson Education
3	Strength of Materials	R. Subramanian	OXFORD University Press
4	Strength of Materials	S S Bhavikatti	Vikas Publishing House Ltd
5	Strength of Material	A. Pytel & F. L. Singer	AWL Inc
6	Engineering Mechanics	J. L. Mariam	John Willey
7	Engineering Mechanics	I. H. Shames	PHI
8	Strength of Materials	S. S Rattan	McGraw Hill Education Pvt. Ltd.

Course Outcome:

After going through this course, the students will be able to:

1. Illustrate the equilibrium conditions and the concept of centre of gravity, moment of inertia of various sections.
2. Explain the elastic properties of ductile and brittle materials through stress-strain curves.
3. Determine various types of forces and stresses developed in structural elements.
4. Calculate the bending moment, shear force and deflection of beams along with developed strain energy under various loads and shear center and shear flow of prismatic sections.
5. Identify torsional moment and twist on a circular shaft.
6. Calculate the buckling load of columns using Euler's theory for different support conditions.

Tapas Sadhu

Course Name: SOIL MECHANICS - I					
Course Code: CIVL 2102					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Objective:

The course will assist the students to:

[1] Indentify different types of rock and understand their properties.
[2] Classify soil as per grain size distribution curve and understand the index properties of soil.
[3] Apply the concept of total stress, effective stress and pore water pressure for solving geotechnical problems.
[4] Apply the knowledge of permeability and seepage in solving flow problems in soil mechanics.
[5] Calculate vertical stress within a soil mass subjected to different types of loading on the ground surface and draw pressure isobar.

Sl. No.	Module	Details of Course Contents	Hours	Total
1	I	**PROPERTIES AND CLASSIFICATION OF ROCKS** **Classification and physical properties of minerals**. **Classification of rocks**: Igneous Rocks: Origin, mode of occurrence, forms & texture, classification and engineering importance, Sedimentary Rocks: Process of sedimentation, classification and engineering importance, Metamorphic Rocks: Agents and types of metamorphism, classification and engineering importance. **Weathering and Erosion of rocks**: Agents and kinds of weathering, soil formation & classification based on origin. **Engineering properties of rocks**: Porosity, permeability, compressive strength, tensile strength and abrasive resistance. **Structural Geology**: Introduction to structural elements of rocks, dip & strike, definition, description, classification of folds, faults and joints.	10	40
2	II	**PROPERTIES AND CLASSIFICATION OF SOILS** **Soil Formation and Characterization**: Introduction, Origin of Soil, Formation and Types of soil, Formative classification, Typical Indian Soil, Some Special Types of Soils, Structure and Composition, Clay Mineralogy. **Soil Phase Relationships**: Weight - Volume Relationship, Density, Unit weight, Moisture Content,	10	

		Specific Gravity, Relative density, Functional Relationships. **Index Properties:** Introduction, Particle Size Distribution, Mechanical Analysis - Sieve Analysis, Sedimentation Analysis – Hydrometer and Pipette Methods. Consistency of Soil – Atterberg Limits, Different Indices, Discussion on Limits and Indices. **Classification**: Classification by Structure, Particle Size Classification, Textural System, PRA System (AASHTO Classification), Unified Classification System, As per IS Code Recommendation, Field Identification of Soils, Classification by Casagrande's Plasticity Chart.		
3	III	**SOIL WATER SYSTEM** **Effective Stress and Pore Water Pressure:** Modes of Occurrence of Water in Soil – Free Water, Held Water, Structural Water, Capillary Water, Gravitational Water, Adsorbed Water, Pore Water, Pore Water Pressure, Effective Pressure, Total Pressure, Effective Pressure under Different Conditions and in Different Cases of Flow through Soils, Critical Hydraulic Gradient, Quick Sand Condition. **Permeability**: Introduction, Darcy's Law, Coefficient of Permeability, Discharge Velocity, Seepage Velocity, Factors affecting Permeability, Determination of Coefficient of Permeability by Constant and Falling Head Methods, Permeability of Stratified Soil Deposits, Field Determination of Permeability for Unconfined and Confined Aquifers. **Seepage**: Introduction, Flow net, Properties and Use of Flow net, Estimation of Seepage loss, Seepage Pressure, Two Dimensional Flow, Laplace's Equations, Flow through Earthen Dam, Piping and Heaving, Uplift pressure, Design of Filters.	10	
4	IV	**STRESS DISTRIBUTION IN SOILS** Introduction, Geostatic Stress, Boussinesq's and Westergaard's Theories regarding Vertical Stress Distribution due to Point Load, Determination of Vertical Stress due to Line and Strip Loads, Vertical Stress under Uniformly Loaded Circular Area, Isobar and Pressure Bulb, Vertical Stress Beneath a Corner of a Rectangular Area, Point Load Method, 2:1 Method, Newmark's Influence Chart, Contact Pressure.	10	

Tapas Sadhu

RECOMMENDED BOOKS:

TEXT BOOKS	
Sl. No.	Name of the books
1.	Singh, P., *Engineering and General Geology*, Katson Publishing House Delhi.
2.	Reddy, D. V., *Engineering Geology for Civil Engineers*, Oxford, IBH.
3.	Billings, M. P., *Structural Geology*, Wiley Eastern Prentice-Hall, U.S.A.
4.	Murthy, V.N.S., *Textbook of Soil Mechanics and Foundation Engineering (Geotechnical Engineering Series)*, CBS Publishers and Distributors Pvt. Ltd.
5.	Punmia, B.C. and Jain, A. K., *Soil Mechanics and Foundations*, Laxmi Publications (P) Ltd.
6.	Das, B. M., *Principles of Geotechnical Engineering*, Thomson Brooks / Cole

REFERENCE BOOKS	
Sl. No.	**Name**
1.	Tyrell, G. W., *The Principles of Petrology*, Springer.
2.	Lambe T. W. and Whitman, R.V., *Soil Mechanics*, Wiley Eastern Ltd.
3.	Holtz, R. D., Kovacs, W. D. and Sheahan, T. D., *An Introduction to Geotechnical Engineering*, Pearson Publication.
4.	Terzaghi, K., Peck, R. B. and Mesri, G., *Soil Mechanics in Engineering Practice*, A Wiley Interscience Publication (John Wiley & Sons, Inc.).
5.	Singh, A., *Soil Engineering in Theory & Practice (Vol.1, 2 & 3)*, Jain Book Agency Publishers.

Course Outcome:

After going through this course, the students will be able to:

[1] Indentify the properties of rocks and which one is suitable for construction purpose.
[2] Classify soil as per grain size distribution curve and understand the index properties of soil.
[3] Apply the concept of total stress, effective stress and pore water pressure for solving geotechnical problems.
[4] Assess the permeability of different types of soil and solve flow problems.
[5] Estimate the seepage loss, factor of safety against piping failure using flow net related to any hydraulic structure.
[6] Determine vertical stress on a horizontal plane within a soil mass subjected to different types of loading on the ground surface and also the maximum stressed zone or isobar below a loaded area.

Tapas Sadhu

Course Name: CONSTRUCTION MATERIALS AND TECHNOLOGY					
Course Code: CIVL 2103					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Objective:

The course will assist the students to:

1. To familiarize the students about the characteristics of construction materials used in civil engineering
2. To develop the skills for identification of suitable construction materials for civil engineering projects.
3. To develop the skills for identification of proper technology that deals with the construction.
4. To identify the factors to be considered in construction of buildings and develop the construction practices and techniques.

SL. No	Module	Details of Course Content	Hours	Total
1	I	**Construction Materials I** **Bricks** Introduction, Classification, Characteristics of good bricks, Ingredients of good brick earth, Harmful substance in brick earth, Testing of bricks, Fly ash brick. **Cement** Introduction, Chemical Composition of Cement, Hydration of Cement, Types of Portland Cement, Tests on Cement and Cement Paste **Aggregates** Introduction, Classification, Mechanical and Physical Properties, Deleterious Substances, Alkali-Aggregate Reaction. Testing of Aggregates **Lime** Introduction, Classification, Slaking and hydration **Steel** Composition, properties, manufacturing, uses. **Paints, Enamels and Varnishes** Composition of oil paint, characteristic of an ideal paint, enamels, distemper, water wash and colour wash, Varnish	**2** **4** **3** **1** **1** **1**	**42**

Tapas Sadhu

2	**II**	**Construction Materials II: Concrete** **PROPERTIES OF FRESH CONCRETE** Workability, Factors Affecting Workability, Tests on workability Segregation, Bleeding, Setting time, Mixing and Vibration of Concrete, Mixers and Vibrators, Curing Methods, Maturity. **STRENGTH OF CONCRETE** Water/Cement ratio, Gel/Space ratio, Compression Test on Cubes, Cylinders, Flexural strength of concrete **ADMIXTURES** Different types, Effects and uses. **MIX DESIGN by I.S. 10262(2009)**	**4** **4** **1** **3**	
3	**III**	**Construction Technology -I** **Foundations** Function of Foundations, Essential requirement of good foundation, Different types of shallow and deep Foundations. **Brick masonry** Definitions, Rules for bonding, Type of bonds, Comparison of English Bond and Flemish Bond **Walls, Doors and Windows** Load bearing wall, Partition wall, and Reinforced brick wall. Common types of doors and windows of timber and metal.	**4** **4** **2**	
4	**IV**	**Construction Technology -II** **Stairs** Technical Terms, Requirements of good stair, Dimension of steps, Classification, Geometric design of a dog legged stair case. **Flooring** Components of a floor, selection of flooring materials, Brick flooring, Cement concrete flooring, mosaic, marble, Terrazzo flooring, Tiled roofing. Centering and Shuttering, Plastering and Pointing: Plastering with cement mortar, Defects in plastering, pointing, White washing, colour washing, Distempering. **Roofs** Types, Pitched roofs and their sketches, **Truss**: Various types of trusses, Roof Covering materials: AC sheets GI sheet.	**2** **2** **2** **1** **1**	

RECOMMENDED BOOKS:

TEXT BOOKS

Sl. No.	**Name of the books**
1.	Duggal S.K. *Building Materials* , New Age International
2.	Varghese P.C. *Building Materials*, PHI Learning Pvt. Ltd-New Delhi.
3.	Punmia B.C. *Building Construction*, Laxmi Publications.

REFERENCE BOOKS

Sl. No.	**Name of the books**
1.	M. S. Shetty R. *Concrete Technology*, S. Chand.
2.	Nevile A.M. & Brooks J.J. *Concrete Technology*, Pearson Education.
3.	S.C. Rangwala *Engineering Materials*, Charotar Publishing

Course Outcome:

After going through this course, the students will be able to:

1. Impart knowledge regarding the various building and general construction products and their quality, durability and availability.
2. Impart knowledge regarding the various types of properties, uses and variety of materials used in the construction industry.
3. Study the behavior of concrete at its fresh and hardened state
4. Study about the concrete design mix.
5. Expose themselves to various quality control aspects of the civil engineering materials.
6. Learn and use the terms common in the building industry.

Tapas Sadhu

References/Books

1. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd
2. D. De, D. De, Fundamentals of Environment & Ecology, S. Chand & Company Ltd.

Course Outcome:

The course outcomes of the subject are

1. Understand the natural environment and its relationships with human activities.
2. Characterize and analyze human impacts on the environment.
3. Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
4. Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.
5. Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.
6. Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Course Name: STRENGTH OF MATERIALS LAB					
Course Code: CIVL 2151					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course objective:

The course will assist the students to:

1. Provide the idea about the method of finding out the tensile, compressive and bending strengths of materials.
2. Construct the ability among students about the concepts of torsion test.
3. Explain the procedure of test requirement of hardness and impact tests.
4. Give an ability to have a concept of stiffness of spring and the procedure to find experimentally its value.

List of Experiments:

1. Tension test on structural materials: Mild steel and TMT bar.
2. Compression test on structural materials: Timber, bricks and concrete cubes.
3. Bending test on mild steel beam and concrete beam.
4. Torsion test on mild steel circular bar.
5. Hardness tests on ferrous and non-ferrous metals: Brinnel and Rockwell tests.
6. Test on closely coiled helical spring / leaf spring.
7. Impact tests: Izod and Charpy.
8. Demonstration of Fatigue test.

Course Outcome:

After going through this course, the students will be able to:

1. Demonstrate the method and findings of tension and compression tests on ductile and brittle materials.
2. Explain the method of bending tests on mild steel beam and concrete beam.
3. Demonstrate the method and findings of Torsion test on mild steel circular bar and concrete beam.
4. Illustrate the concept of hardness and explain the procedure and findings of Brinnel and Rockwell tests.
5. Demonstrate the concept and procedure of calculation of spring constant and elaborate its use in Civil Engineering.
6. Demonstrate the method and findings of Izod and Charpy impact tests.
7. Understand the concepts of fatigue test.

Course Name: **SOIL MECHANICS LAB - I**					
Course Code: CIVL 2152					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Objective:

The course will assist the students to:

1. Distinguish different types of soils and rock samples by visual inspection.
2. Identify microscopic structure of rocks and minerals.
3. Determine index properties of different types of soils.
4. Interpret the grain size distribution curve for different types of soils.
5. Identify co-efficient of permeability and compaction characteristics of different types of soils.

List of Experiments:

1. Field identification of different types of soils as per Indian Standards [collection of field samples and identifications without laboratory testing].
2. Identification of rocks and minerals [Hand Specimens].
3. Microscopic study of rocks and minerals.
4. Determination of natural moisture content.
5. Determination of specific gravity of cohesionless and cohesive soils.
6. Determination of grain size distribution by sieve and hydrometer analyses.
7. Determination of Atterberg limits (liquid limit, plastic limit and shrinkage limit).
8. Determination of co-efficient of permeability by constant and variable head permeability tests.
9. Determination of in-situ density by core cutter method and sand replacement method.
10. Determination of compaction characteristics of soil by standard Proctor compaction test.

REFERENCE BOOKS & CODES:	
Sl. No.	**Name**
1.	Das, B.M. *Soil Mechanics Laboratory Manual*, Oxford university press.
2.	SP 36 (Part I & II): *Compendium of Indian Standards on Soil Engineering*.

Tapas Sadhu

Course Outcome:

After going through this course, the students will be able to:

1. Classify visually different types of soils and rock samples as obtained in the field.
2. Interpret the microscopic nature of rocks involved in the analysis and design of foundations embedded in it.
3. Determine the index properties of soil to understand different types of soils as obtained from field investigation.
4. Identify different types of soils from the nature of grain size distribution.
5. Assess the co-efficient of permeability of different types of soils for analysis of flow problems in soil mechanics.
6. Determine the compaction characteristics of soil to identify whether it is suitable for use in embankment construction.

Tapas Sadhu

Course Name: **CONSTRUCTION MATERIALS LAB**					
Course Code: CIVL 2153					
Contact hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Objective:

The course will assist the students to develop:

1. the skills on the test of cement
2. the skills on test of aggregates.
3. an ability to perform the test of fresh and hardened concrete.
4. an ability to perform the concrete mix design.

List of Experiments:

1. **Tests on cement –** specific gravity, fineness, soundness, normal consistency, setting time, compressive strength on cement mortar cubes
2. **Tests on fine aggregate** – specific gravity, bulking, sieve analysis, fineness modulus, moisture content, bulk density and deleterious materials.
3. **Tests on coarse aggregate** - specific gravity, sieve analysis, fineness modulus and bulk density.
4. **Tests on Fresh Concrete**: Workability: Slump, Vee-Bee, Compaction factor tests
5. **Hardened Concrete**: Compressive strength on Cubes, Split tensile strength, Static modulus of elasticity, Flexure tests, Non destructive testing (Rebound hammer & Ultrasonic pulse velocity)
6. **Mix Design of Concrete**.

References:

1. Relevant latest IS codes on Aggregates, Cement & Concrete [269, 383, 2386, 10262(2009), SP23]
2. Laboratory manual of concrete testing by V.V. Sastry and M. L. Gambhir

Course Outcome:

After going through this course, the students will be able to:

1. Outline the importance of testing of cement and its properties
2. Assess the different properties of aggregate
3. Summarize the concept of workability and testing of concrete
4. Describe the preparation of fresh concrete
5. Describe the properties of hardened concrete.
6. Develop mix design of concrete as per provision of the IS Codes.

Tapas Sadhu

Course Name: BUILDING PLANNING & DRAWING					
Course Code: CIVL 2154					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	4	4	2

Course Objectives:

The course will assist the students to:

1. Increase ability to communicate with people
2. Learn to sketch and take field dimensions.
3. Learn to take data and transform it into graphic drawings.
4. Learn basic Auto Cad skills.
5. Learn basic engineering drawing formats.
6. Prepare themselves for future Engineering positions

FOUNDATIONS

- Footing for a RCC column and Brick wall.
- Combined footing.
- Strip footing.
- Raft foundation.
- RCC Pile Foundation.

DOORS, WINDOWS AND STAIRS

- Glazed and paneled doors of standard sizes.
- Glazed and paneled windows of standard sizes.
- Special windows and ventilators.
- Proportioning and planning of dog-legged and open well staircase.

ROOFS AND TRUSSES

- Types of sloping roofs, lean-to-roofs, RCC roof.
- King post and Queen post trusses.

FUNCTIONAL DRAWING OF BUILDINGS

- To draw the line diagram, plan, elevation and section of Residential Buildings (flat, pitched and combined roofs), Office Buildings (flat roof) showing positions of various components including lift well and their sizes, load bearing wall and column.
- Details of plumbing and sanitary lines, septic tank.

Tapas Sadhu

Reference Books:

Sl No.	Title	Author
1	Principles of Building Drawing	Shah & Kale
2	Text Book of Building Construction	Sharma & Kaul
3	Building Construction	BC Punmia
4	Civil Engineering Drawing	M. Chakraborti

Course Outcomes:

After going through this course, the students will be able to:

1. Draw the plan, section and elevation of a building
2. Select, construct and interpret appropriate drawing scale as per the situation.
3. Layout development of solids for practical situations, architectural and engineering scales will increase.
4. Have knowledge in details about every individual section of a building, truss, doors and windows and detailed information about the different types of foundation.
5. Have the ability to perform basic sketching techniques.
6. Convert sketches to engineering drawings and become familiar with office practice and standards.

Tapas Sadhu

Course Name: FLUID MECHANICS					
Course Code: CIVL 2113					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Objective:

The course will assist the students to:

1. Introduce themselves to the fundamental aspects of fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
2. Learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.
3. Develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
4. Imbibe basic laws and equations used for analysis of static and dynamic fluids.
5. Inculcate the importance of fluid flow measurement and its applications in Industries.
6. Determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.

Sl. No.	Module	Details of course contents	Hours	Total
1.	I	**FLUID STATICS** Fluid pressure at a point, Variation of pressure within a static fluid, measurement of pressure, total fluid pressure on plane and curved areas, Center of pressure, buoyancy, stability of submerged and floating bodies, meta-centre.	4	44
		FUNDAMENTALS OF OPEN CHANNEL FLOW Scope and importance, characteristics of open channel flow, distinction between pipe flow and open channel flow, types of flow: Steady, Unsteady; Uniform, Non uniform, Gradually varied flow, Rapidly varied flow (definition only).	4	
		STEADY UNIFORM FLOW IN OPEN CHANNEL Characteristics, Chezy's, Manning's formulae, Hydraulically efficient Rectangular and trapezoidal sections. Design features of rigid boundary channels.	4	
2.	II	**WEIRS AND NOTCHES** Rectangular, triangular, trapezoidal and cippoletti notch, sharp crested and broad crested weirs, submerged weirs.	4	
		FLOW THROUGH PIPES Laminar and turbulent flow through pipes, Reynold's number, fluid friction in pipes, head loss due to friction. Darcy- Weisbach equation, Friction factors for commercial pipes, use of Mody's diagram, minor losses in pipes, basic concept of boundary layer, drag, lift, concept of water hammer and surge tank.	6	

Tapas Sadhu

3.	**III**	**SPECIFIC ENERGY / NON-UNIFORM FLOW IN OPEN CHANNEL** Definition, Diagram. Critical, Sub-critical and Supercritical flows. Establishment of critical flow, Specific force: Definition and diagram, Hydraulic Jump.	4	
		DIMENSIONAL ANALYSIS AND MODEL STUDIES Dimensions and dimensional homogeneity, Importance and use of dimensional analysis.	2	
		Buckingham Pi Theorem**:** Statement and application, Geometric, Kinematic and Dynamic similarity. Non Dimensional Numbers, Froude and Reynold model laws and applications.	4	
4.	**IV**	**MACHINERIES IN FLUID MECHANICS** Turbines, Classification and types, power and efficiency, Working Principles of Pelton, Francis and Kaplan turbines, draft tube, Cavitations in pumps and turbines.	6	
		Application of principles of similarity of hydraulic machines, specific speed of pumps and turbines, centrifugal and reciprocating pumps, performance characteristics graph for head, discharge and efficiency, hydraulic machines in parallel and series, hydraulic Ram.	6	

RECOMMENDED BOOKS:

TEXT BOOKS	
Sl. No.	Name of the book
1	Modi P.N. and Seth S.M., *Hydraulics and Fluid Mechanics including hydraulics machines*, 19th edition, Standard Book House
2	Pati S., *A textbook of Fluid mechanics and Hydraulic machines,* 1st edition, McGraw Hill Education (India) Pvt Ltd
3	Som S.K., Biswas G. and Chakraborty S., *Introduction to fluid mechanics and fluid machines*, 3rd edition, McGraw Hill Education (India) Pvt Ltd
4	Ojha C.S.P., Berndtsson R. and Chandramouli P.N., *Fluid Machines and Machinery*, 1st edition, Oxford University Press

Tapas Sadhu

REFERENCE BOOKS	
Sl. No.	Name of the book
1	Cengel Y. A. and Cimbala J. M., *Fluid Mechanics: Fundamentals and Applications*, 2^{nd} edition, Tata McGraw Hill Education Private Limited
2	Pritchard P.J. and Leylegian J.C., *Fox and McDonald's Introduction to Fluid Mechanics*, 8^{th} edition, John Wiley & Sons
3	Massey B.S. and Ward-Smith John., *Mechanics of Fluids*, 9th edition, Taylor & Francis.
4	Bansal R.K., *A textbook of Fluid Mechanics and Hydraulic Machines*, 9^{th} edition, Laxmi Publications (P) Ltd

Course Outcome:

After going through this course, the students will be able to:

1. Understand basic fluid properties (density, viscosity, bulk modulus), flow forces (pressure, shear stress, surface tension) and flow regimes (laminar/turbulent, compressible/ incompressible, steady/unsteady).
2. Use and know limitations of steady and unsteady Bernoulli equation along and normal to a streamline.
3. Explain the conservation of mass and momentum through differential analysis in simple geometries.
4. Study scope, importance, characteristics and various types of flows in an open channel.
5. Understand the techniques of dimensional analysis, similitude and modeling and introduce the important non-dimensional groups in fluid mechanics.
6. Know the concepts to internal and external flows and introduce the boundary layer concept, lift and drag, flow separation, and drag reduction fundamentals.

Tapas Sadhu

Course Name: **FLUID MECHANICS LAB**					
Course Code: CIVL 2163					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Objective:

The course will assist the students to:

1. Be acquainted with the fundamentals of fluid mechanics.
2. Practice in the analytical formulation of fluid mechanics problems using Newton's Laws of motion and thermodynamics.
3. Be acquainted with the introduction to experimental method.
4. Get exposure to practical applications, work on a small design project, and the writing of a technical report related to the design project.
5. Discuss and practice standard measurement techniques of fluid mechanics and their applications.
6. Impart knowledge in measuring pressure, discharge and velocity of fluid flow.

List of Experiments:

1. To determine the coefficient of discharge for an Orifice meter
2. Calibration of V- Notch
3. Determination of Co-efficient of Discharge for Venturimeter
4. Measurement of velocity of fluid in pipe using a pitot tube
5. Measurement of water surface profile for flow over Broad crested weir
6. To verify Bernoulli's equation experimentally
7. Measurement of water surface profile for a hydraulic jump
8. Determination of efficiency of a Centrifugal pump
9. Determination of efficiency of a Pelton wheel Turbine
10. Determination of efficiency of a Francis Turbine

REFERENCE BOOKS:

Sl. No.	Name of the book
1	Laboratory Manual: Hydraulics and Hydraulic Machines by R. V. Raikar, PHI Learning.
2	Laboratory manual for Civil Engineering second edition by H S Moondra and R Gupta, CBS Publishers, New Delhi.
3	Fluid Mechanics by Modi & Seth Standard Book House, New Delhi.
4	Fluid Mechanics by A.K.Jain, Khanna Publishers, Nath Market, Nai Sarak, New Delhi.
5	Fluid Mechanics & Machinery by H. M. Raghunath – CBS Publishers, New Delhi.

Tapas Sadhu

Course Outcome:

After going through this course, the students will be able to:

1. Apply the basic equation of fluid statics to determine forces on planar and curved surfaces that are submerged in a static fluid; to manometers; to the determination of buoyancy and stability; and to fluids in rigid-body motion.
2. Use the conservation laws in integral form and apply them to determine forces and moments on surfaces of various shapes and simple machines.
3. Use the conservation laws in differential forms and apply them to determine velocities, pressures and acceleration in a moving fluid.
4. Determine flow rates, pressure changes, minor and major head losses for viscous flows through pipes, ducts, simple networks and the effects of pumps, fans, and blowers in such systems.
5. Apply principles of fluid mechanics to the operation, design, and selection of fluid machinery such as pumps and turbines.
6. Use Euler's and Bernoulli's equations and the conservation of mass to determine velocities, pressures, and accelerations for incompressible and inviscid fluids.

Tapas Sadhu

Course Name: STRUCTURAL ANALYSIS -I					
Course Code: CIVL 2201					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Objective:

The course will assist the students to:

1. Introduce themselves to concept of global structural stability, theory of structural analysis, and methods in structural analysis.
2. Develop an idea to model a structure with proper loads and support conditions.
3. Build an ability to idealize and analyze statically determinate and indeterminate structures.
4. Provide knowledge among on moving loads and procedure to calculate the influence line diagram of several functions for beams and truss.

Module I [16L]

BASICS OF STRUCTURAL ANALYSIS

(i) Concept of static and kinematic indeterminacy, Determination of degree of indeterminacy for different types of structures.

(ii) Theorem of minimum potential energy, law of conservation of energy, principle of virtual work, the first theorem of Castigilano, Betti's law, Clark Maxwell's theorem of reciprocal deflection.

ANALYSIS OF DETERMINATE STRUCTURES

Portal Frames, Three hinged arches, Cables.

DEFLECTION OF DETERMINATE STRUCTURES

Energy methods. Unit Load method for beams, Deflection of trusses and Simple Portal Frames.

Module II [6L]

INFLUENCE LINE DIAGRAM

Statically determinate beams and trusses under series of concentrated and uniformly distributed rolling loads, criteria for maximum and absolute maximum moments and shear.

Module III [16 L]

THEOREM OF THREE MOMENTS

Introduction to statically indeterminate structures, advantages of indeterminate structures over determinate structures, solved simple numerical problems on computation of static indeterminacy, Clapeyron's theorem of three moments, derivation of three moment equation, solved numerical problems of continuous beams based on different support conditions and support settlement.

Tapas Sadhu

STRAIN ENERGY

Castigliano's 2nd Theorem; solved numerical problems.

ANALYSIS OF STATICALLY INDETERMINATE BEAMS BY FORCE METHOD

Basic introduction to force method of analysis, analysis of statically indeterminate beams by force method, Solved examples, Theorem of Least work, numerical problems on theorem of least work.

TWO HINGED ARCHES

Analysis of two hinged arch, solved problems on two hinged arch.

Module IV [4L]

INFLUENCE LINE DIAGRAM OF INDETERMINATE STRUCTURES

Influence lines for statically indeterminate beams, Muller- Breslau Principle, ILD for continuous beams, Problems on ILD for continuous beam, trusses etc.

Text & References:

Sl. No.	Name	Author	Publishers
1.	Basic Structural Analysis	C.S.Reddy	Tata Mc Graw Hill
2.	Statically Indeterminate Structures	C.K.Wang	Mc Graw Hill
3.	Structural Analysis-A unified Classical and Matrix Approach.	A. Ghali and A.M.Neville	E & FN SPON
4.	Theory of Structures	Timoshenko and Wang	Tata Mc Graw Hill
5.	Engineering Mechanics of Solids	E.P.Popov	Pearson Education

Course Outcomes

After going through this course, the students will be able to:

1. Distinguish between stable and unstable and statically determinate and indeterminate structures.
2. Apply equations of equilibrium to structures and compute the reactions.
3. Calculate the internal forces in cable and arch type structures
4. Evaluate and draw the influence lines for reactions, shears and bending moments in beams due to moving loads.
5. Use approximate methods for analysis of statically indeterminate structures.
6. Calculate the deflections of truss structures and beams.

Tapas Sadhu

Course Name: SOIL MECHANICS - II					
Course Code: CIVL 2202					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Objective:

The course will assist the students to:

1. Gain an in-depth knowledge of the shear strength characteristics of soils.
2. Assess the consolidation and compaction properties of soils.
3. Determine the lateral earth pressure on rigid retaining wall and design it accordingly.
4. Investigate the stability of soil slopes under different conditions.

Sl. No.	Module	Details of Course Content	Hours	Total
1.	I	**SHEAR STRENGTH** Introduction, Basic Concept of Shear Resistance and Shear Strength of Soil, Mohr Circle of Stress, Sign Conventions, Mohr - Coulomb Theory, Relationship between Principal Stresses for both Cohesive and Cohesionless Soils, Stress Controlled and Strain Controlled Tests, Laboratory Determination of Soil Shear Parameters - Direct Shear Test, Unconfined Compression Test, Vane Shear Test, Triaxial Test as per Relevant IS Codes, Classification of Shear Tests Based on Drainage Conditions, Stress - Strain Relationship of Clays and Sands, Concept of Critical Void Ratio. Skempton's Pore Pressure Parameters, Introduction to Stress path.	10	40
2.	II	**CONSOLIDATION & COMPACTION** **Consolidation**: Introduction, Terzaghi's theory of one dimensional consolidation, Compressibility characteristics of soils, Compression index, Coefficients of Compressibility and Volume Change, Coefficient of consolidation, Degree and Rate of Consolidation, Time factor, Settlement computation, Laboratory One Dimensional Consolidation Test as per IS Code, Determination of Consolidation Parameters. **Compaction:** Introduction, Standard and Modified Proctor Compaction tests, Field Compaction methods, Factors affecting compaction, Factors affecting Compaction Characteristics of Soil.	10	
3.	III	**EARTH PRESSURE & STABILITY OF**	10	

Tapas Sadhu

		CONCRETE RETAINING WALLS **Lateral Earth Pressure**: Introduction, Plastic equilibrium of soil, Earth Pressure at Rest, Active and Passive Earth Pressures, Rankine's and Coulomb's Earth Pressure Theories, Determination of Active and Passive Earth Pressures under different conditions, Analytical and Graphical methods for Determination of Earth pressure against various Earth Retaining Structures. **Stability of Concrete Retaining Walls:** Stability checks for Cantilever retaining wall against Overturning, Sliding and Bearing Capacity.		
4.	IV	**STABILITY OF SLOPES** Introduction, Types of failure, Different types of Factor of safety, Analysis of infinite and finite slopes, Stability of Clay Slopes under Undrained Condition, Friction circle method, Taylor's stability number, Ordinary or Swedish or Fellenius method of slices, Bishop's simplified method of stability analysis.	10	

RECOMMENDED BOOKS:-

TEXT BOOKS	
Sl. No.	**Name**
1.	Murthy, V.N.S., *Textbook of Soil Mechanics and Foundation Engineering* (Geotechnical Engineering Series), CBS Publishers and Distributors Pvt. Ltd.
2.	Punmia, B.C. and Jain, A.K., *Soil Mechanics and Foundations*. Laxmi Publications (P) Ltd.
3.	Das, B.M., *Principles of Geotechnical Engineering*, Thomson Brooks / Cole.
4.	Ranjan, G. and Rao, A.S.R., *Basic and Applied Soil Mechanics*, New Age International Pvt. Ltd, Publishers.

REFERENCE BOOKS	
Sl. No.	**Name**
1.	Lambe, T. W. and Whitman, R.V., *Soil Mechanics*, Wiley Eastern Ltd.
2.	Holtz, R. D., Kovacs, W. D. and Sheahan, T. D., *An Introduction to Geotechnical Engineering*, Pearson Publication.
3.	Terzaghi, K., Peck, R. B. and Mesri, G., *Soil Mechanics in Engineering Practice*, A Wiley Interscience Publication (John Wiley & Sons, Inc.).
4.	Craig, R. F., *Craig's Soil Mechanics*, Spon Press (Taylor and Francis Group)

Tapas Sadhu

Course Outcome:

After going through this course, the students will be able to:

1. Apply the concept of shear strength to analyze different geotechnical problems and determine the shear strength parameters from lab and field tests.
2. Assess the compaction characteristics of soil for solving geotechnical problems.
3. Estimate the consolidation settlement using relevant parameters for a soil.
4. Calculate earth pressure on rigid retaining walls on the basis of classical earth pressure theories.
5. Analyze and design rigid retaining walls (cantilever types) from geotechnical engineering consideration.
6. Compute safety of dams and embankments on the basis of various methods of slope stability analysis.

Tapas Sadhu

Course Name: **SURVEYING**					
Course Code: CIVL 2203					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Objective:

The course will assist the students to:

1. Provide the knowledge of the importance of surveying in the field of civil engineering
2. Study the basics of linear/angular measurement methods like chain surveying, compass surveying, etc.
3. Develop the basic knowledge levelling and theodolite survey in elevation and angular measurements
4. Build an idea about the advanced surveying instruments used in present days.

Module I [8L]

BASICS OF SURVEYING

Introduction to Surveying
Definition, principles of surveying, types of scales (numerical problems), basic concepts of plans and maps.
Chain and compass Surveying
Basic introduction to different types of chains and accessories, errors in chain surveying, Basic concept and terminologies related to compass survey, local attraction and its elimination, open and closed traverse.
Plane Table Surveying
Principle, equipment and methods, two and three point problems.

Module II [12L]

METHODS OF MEASUREMENT

Levelling and Contouring
Definitions and terminology, types and methods of levelling, use of Dumpy level, Auto level and supporting accessories, different terms used in contouring, characteristics of contour and contour interval.
Theodolite Surveying and Tacheometry
Components of Theodolite, adjustments, measurement of vertical and horizontal angels, concepts of trigonometric levelling, definitions and principles of tacheometry and stadia system, fixed hair stadia method, calculation of horizontal and vertical distance using tacheometer.

Module III [12L]

COMPUTATION PROCEDURE AND SETTING OUT WORKS

Computation of Area and Volume
Computation of area using trapezoidal rule and Simpson's 1/3rd rule. Computation of volume of different cross sections.
Setting out of Horizontal Curves
Elements of simple circular curves and methods of setting out simple circular curve by linear and angular methods. Requirements, types and elements of transition curve.
Setting Out Of Vertical Curves
Introduction to vertical curves and its types.

Module IV [8L]

INTRODUCTION TO HIGHER SURVEYING
Measurement Procedure Using Advanced Instruments
Total Station and its different parts, practical application of Total Station.
Triangulation
Concepts of triangulation and triangulation systems in brief.
Hydrographic Survey
Shoreline survey, soundings, locating soundings and reduction of soundings, basic concept of Mean sea level, bathymetry.
Aerial Photogrammetry
Terminology, equipments and photo-theodolite

Reference books

Sl. No.	Name of the Books
1.	Duggal S. K. *Surveying (Vol-1 and 2).* 4th edition, McGraw Hill Education (India) Pvt Ltd.
2.	Roy S.K. *Fundamentals of Surveying*. 2nd edition, PHI Learning Pvt. Ltd-New Delhi.
3.	Punmia B.C., Jain A.K. and Jain A.K. *Surveying (Vol-1 and 2).* 15th edition, Laxmi Publications (P) Ltd.
4.	Bannister A., Raymond S. and Baker R. *Surveying*. 1st edition, Pearson India.
5.	Subramanian R. *Surveying and Levelling*. 2nd editon, Oxford university Press.

Tapas Sadhu

Course Outcome:

After going through this course, the students will be able to:

1. Study the basics of linear/angular measurement methods like chain surveying, compass surveying.
2. Understand the concepts of leveling and contouring.
3. Demonstrate the method of theodolite survey in terms of elevation and angular measurements, along with tacheometry.
4. Calculate the area and volume of any given land using different methods and rules.
5. Understand the method of setting out procedure of horizontal and vertical curves.
6. Explain various methods of higher surveying, such as triangulation, hydrographic survey, areal photogramatry and demonstrate the basic functions of advanced instrument like Total station.

Tapas Saha

Course Name: HIGHWAY AND TRAFFIC ENGINEERING					
Course Code: CIVL 2204					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Objectives:

The course will assist the students to:

1. Provide the knowledge of Highway Network Planning, Highway alignment and Highway Geometric Design.
2. Study different pavement materials and design different types of pavements.
3. Building and idea about Highway Construction including the drainage and its maintenance and safety.
4. Develop and idea of Traffic engineering, Traffic Signal Design and Design of at grade Intersections:
5. Analyse Parking and Accident in Transport System.

Module I [12L]

Highway Network Planning:
Different modes of transportation, Role & Development of highway transportation, Classification, Network patterns, Planning surveys, Evaluation by saturation system, Introduction to highway economics.
Highway Alignment:
Factors controlling alignments, Principles of highway alignment, engineering surveys for highway alignment and location.
Highway Geometric Design:
Importance of geometric design, design controls, pavement cross-sectional elements, PIEV theory, Sight distance, Design of horizontal alignments, Design of vertical alignments, Geometric Design of Hill Roads.

Module II [12L]

Pavement Materials:
Types and component parts of pavement and their functions, highway and airport pavement materials, basic soil & aggregate properties relevant to pavement application, basic properties of bitumen and tar, Modified Bitumen (PMB, CRMB) tests on pavement materials, Use of geo-synthetics.
Design of Pavements:
Design factors, classification of axle types, contact pressure, EWLF & ESAL concept, Traffic analysis: vehicle damage factor.
Flexible Pavement Design:
Design of flexible pavements (GI method, CBR method, Triaxial method -only introduction), IRC method of design.
Rigid Pavement Design:
Design considerations, Westergaard's theory and assumptions, Design of dowel and tie bars, Joints in Rigid Pavements, IRC method of design.

Tapas Sadhu

Module III [8L]

Highway Construction:
Construction of earth roads, gravel roads, WBM roads, Cement Concrete Pavements, Bituminous pavements.
Highway Maintenance:
Pavement failures, causes of failure, routine and periodic maintenance of highways.
Highway Drainage:
Importance of highway drainage, surface and sub-surface drainage, drainage of slopes and erosion control, road construction in water logged areas.
Highway Safety:
Introduction to highway safety, accident characteristics and factors, accident recording and analysis, road safety audit, safety education, traffic law enforcement, elements of highway safety management system, road safety management system.

Module IV [10L]

Traffic Engineering:
Introduction, road users and vehicle characteristics, microscopic and macroscopic flow characteristics, time headways, interrupted and un- interrupted traffic, speed and travel time variation, travel time and delay studies, flow and density measurement techniques, highway capacity and level of service, level of service estimation, traffic signs.
Traffic Signal Design and Design of at grade Intersections:
Signal phasing, cycle length, fixed and vehicle actuated signal, Webster method, IRC method, signal co-ordination and problems on signal design, types of intersections, rotary and round-about, design aspects.
Parking and Accident Analysis:
Parking inventory study, on street and off street parking facilities, introduction to Intelligent Transport System, accident characteristics, accident recording and analysis.

RECOMMENDED BOOKS:

TEXT & REFERENCE BOOKS	
Sl. No.	Name of the books
1.	High Way Engineering, Khanna & Justo, Nemchand& Brothers, Roorkee
2.	Principles of Transportation Engineering, P. Chakraborty& A. Das - PHI
3.	Transportation Engineering- C.J Khisty& B.K Lall., PHI
4.	Kadiyali L.R. Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, India, 1997
CODES FOR REFERENCE	
Sl. No.	Name of the Codes
1.	I.S Specifications on Concrete , Aggregate & Bitumen Bureau of Indian Standard
2.	Relevant latest IRC Codes (IRC-37 – 2001, IRC-37 – 2012, IRC 58 – 2011, IRC 73 - 1980, IRC 86 - - 1983, IRC 106 – 1990, IRC 64 – 1990, IRC 15- 2002 - Indian Road Congress

Tapas Sadhu

Course Outcome:

After going through this course, the students will be able to:

1. Plan highway networks and Design highway geometrics.
2. Characterize the properties of soil, aggregate, bitumen, and bituminous mixes.
3. Analyze and design rigid and flexible pavement (IRC Method).
4. Understand the principles of construction, maintenance and safety of highways.
5. Conduct traffic studies, analyze traffic data and design intersections.
6. Design traffic signal and analyze parking & accidents.

Tapas Sadhu

Course Name: **SOIL MECHANICS LAB - II**					
Course Code: CIVL 2251					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Objective:

The course will assist the students to:

1. Identify the compressibility characteristics of soil.
2. Determine unconfined compressive strength of cohesive soil.
3. Determine shear strength parameters of soil by vane shear, direct shear and triaxial tests.
4. Identify California Bearing Ratio (CBR) of soil.
5. Explain standard penetration test.

List of Experiments:

1. Determination of compressibility characteristics of soil by oedometer test.
2. Determination of unconfined compressive strength of soil by unconfined compression test.
3. Determination of shear strength parameters of soil by direct shear test.
4. Determination of undrained shear strength of soil by vane shear test.
5. Determination of shear strength parameters of soil by unconsolidated undrained triaxial test.
6. Determination of California Bearing Ratio (CBR) of soil.
7. Standard penetration test.

REFERENCE BOOKS & CODES:	
Sl. No.	**Name**
1.	Das, B.M. *Soil Mechanics Laboratory Manual*, Oxford University Press.
2.	SP 36 (Part I & II): *Compendium of Indian Standards on Soil Engineering*.

Course Outcome:

After going through this course, the students will be able to:

1. Assess the compressibility characteristics of soil to estimate the settlement of the foundation.
2. Interpret the undrained shear strength of cohesive soil from unconfined compression and vane shear tests to evaluate the bearing capacity of proposed foundation to be constructed on the soil.
3. Determine shear strength parameters of both cohesionless and cohesive types of soil by triaxial test for routine geotechnical analysis.
4. Identify friction angle of cohesionless soil by direct shear test for the analysis of geotechnical structures.
5. Assess California Bearing Ratio (CBR) values of soil to select whether that particular soil is suitable for construction of embankment.
6. Analyze the standard penetration test (SPT) results to interpret the type of soil profile and to verify the bearing capacity of foundations from SPT values.

Tapas Sadhu

Course Name: **SURVEYING LAB**					
Course Code: **CIVL 2252**					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	4	4	2

Course Objective:

The main objective of this course is to

1. Develop the concept of taking linear and angular field measurements using different instruments.
2. Provide the idea about the procedure to draw the traverse survey and topographic plan using field data.
3. Develop an idea about the drawing of leveling data and interpret them to calculate the volume of cutting and filling of soil for a particular road profile.
4. Build an idea about the field procedure of setting out of curve and layout drawing on the ground.

List of Experiments:

1. **Chain and Compass survey:** Preparation of maps, method of ranging-method of taking offsets, measurement of bearings, chain and compass traverse.
2. **Levelling:** Temporary adjustment of Dumpy level, Differential leveling, Profile leveling and plotting of long and cross sections.
3. **Theodolite survey:** Traversing using theodolite, preparation of Gale's traverse table using the field data.
4. **Curve setting:** Setting out of simple circular curve and transition curve by angular method.
5. **Setting out of building:** Setting out procedure of building layout.
6. **Total station:** Demonstration of the instrument and perform Levelling using it.

Course Outcome:

After going through this course, the students will be able to:

1. Prepare maps by chain and compass traverse.
2. Perform temporary adjustment of Dumpy level, Differential leveling, Profile leveling and plot long and cross sections.
3. Construct traverse plot using theodolite with the help of Gale's traverse table.
4. Set out circular curve and transition curve and estimate the error in setting out method.
5. Instruct the procedure of setting out of building layout.
6. Demonstrate different parts of a Total station and can perform simple operations of the instrument.

Tapas Sadhu

Course Name: **HIGHWAY ENGINEERING LAB**					
Course Code: CIVL 2253					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course objective:

The course will assist the students to:

1. Conduct different tests to find out the properties of various aggregates.
2. Characterize the pavement materials.
3. Know about quality control of the pavement materials.
4. Know about quality control of aggregates.
5. Design and test bituminous mix.

List of Experiments:

A. Test on Highway Materials:

1. Aggregates –
   a) Impact Value Test.
   b) Los Angeles Abrasion Value Test.
   c) Water Absorption and Specific Gravity.
   d) Elongation and Flakiness Index.
2. Bitumen –
   a) Specific Gravity Test.
   b) Penetration Value Test.
   c) Softening Point Test.
   d) Loss on Heating Test.
   e) Flash and Fire point Test.

B. Bituminous Mix Design by Marshall Stability Method.

C. Stripping Value Test.

References:

1. BIS Codes on Aggregates and Bituminous Materials.
2. Highway Material Testing (Laboratory Manual) by S.K. Khanna and CE. G. Justo.
3. Relevant IS and I.R.C codes.

Course Outcome:

After going through this course, the students will be able to:

1. Learn various concepts in highway engineering.
2. Design and test bituminous mix.
3. Gather knowledge about the quality control techniques of various aggregates and pavement materials.
4. Characterize bituminous grade according to their work suitability.
5. Understand the factors influencing road vehicle performance characteristics and design.
6. Access the quality of different bitumen grade.

Course Name: QUANTITY SURVEY, SPECIFICATION AND VALUATION					
Course Code: CIVL 2254					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Objective:

The course will assist the students to:

1. Know the importance of preparing the types of estimates under different conditions.
2. Know about the rate analysis and bill preparations.
3. Study about the specification writing.
4. Understand the valuation of land and buildings.

1. Introduction of Estimation in Civil Engineering:

Introduction-Principles of estimating, Types of estimates, approximate estimates, items of work, unit of measurement, unit rate of payment.

2. Preparation of Bill of Quantities:

Measurements and calculations of quantities of Civil engineering works, Preparation of abstracts of bill of quantities.

3. Analysis of Rates of different items with specifications:

Specifications for materials and construction of a building. Rate analysis for Earthwork, PCC, Shuttering, Reinforcement, RCC, brick work, plastering, flooring and finishing, Use of standard schedules such as PWD schedules of rates. Specifications.

4. Quantity Estimation of infrastructures:

Quantity estimates of road, Underground reservoir, Surface drain, Septic tank

5. Valuation:

Concept of price, value and cost. Purpose of valuation; free hold and lease hold properties; market value, present value; sinking fund; year's purchase. Different methods of land valuation. Different methods of valuation of real properties. Outgoing, appreciation, depreciation, different methods for fixation of rents. Valuation of plants and machineries.

References:

1. Estimating, costing, Specification and Valuation in Civil Engineering by M. Chakroborty
2. Estimating and Costing in Civil Engineering" by B.N. Dutta, USB Publishers & Distributers
3. IS CODE SP34

Course Outcome:

After going through this course, the students will be able to:

1. Apply different types of estimates in different situations.
2. Prepare quantity estimates for buildings, roads, rails and canal works.
3. Calculate the quantity of materials required for civil engineering works as per specifications.
4. Demonstrate the concepts of specification writing.
5. Evaluate contracts and tenders in construction practices.
6. Prepare cost estimates.

Tapas Sadhu

Syllabus of 3rd Semester

A. THEORY COURSES

Course Name: Data Structures & Algorithms					
Course Code: CSEN2101					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN2111.1. Understand and remember the basics of data structures and how time complexity analysis is applicable to different types of algorithms.

CSEN2211.1. Understand the significance and utility of different data structures and the context of their application. (For example, the queue in front of ticket counters uses first-in-first-out paradigm in a linear data structure)

CSEN2311.1. Apply different types of data structures in algorithms and understand how the data structures can be useful in those algorithms.

CSEN2411.1. Analyse the behaviour of different data structures in algorithms. (For example, given an algorithm that uses a particular data structure, how to calculate its space and time complexity.)

CSEN2511.1. Evaluate solutions of a problem with different data structures and thereby understand how to select suitable data structures for a solution. (For example, what are the different ways to find the second largest number from a list of integers and which solution is the best.)

CSEN2611.1. Evaluate different types of solutions (e.g. sorting) to the same problem.

2. Detailed Syllabus

Module 1 [8L]

Introduction: Why do we need data structure? Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type; Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – Big O, Ω, Θ, notations.

Array: Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.

Linked List: Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Module 2 [8L]

Stack and Queue: Stack and its implementations (using array, using linked list), applications. Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list), applications. Implementation of deque- with input and output restriction.

Recursion: Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle (Concept of Backtracking).

Module 3 [13L]

Trees: Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only).

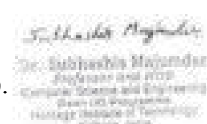
Graphs: Graph definitions and Basic concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut vertex/articulation point, complete graph, simple path, simple cycle). Graph representations/storage implementations – adjacency matrix, adjacency list, Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications.

Module 4 [11L]

Sorting Algorithms: Bubble sort and its optimizations, Cocktail Shaker Sort, Insertion sort, Selection sort, Quicksort (Average Case Analysis not required), Heap sort (concept of max heap, application – priority queue), Counting Sort, Radix sort.

Searching: Sequential search, Binary search, Interpolation search.

Hashing: Hashing functions, collision resolution techniques (Open and closed hashing).



3. Textbooks

1. Fundamentals of Data Structures of C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
2. Data Structures in C, Aaron M. Tenenbaum.
3. Data Structures, S. Lipschutz.

4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

4. Reference Books

1. Data Structures and Program Design In C, 2/E, Robert L. Kruse, Bruce P. Leung.

Course Name: Discrete Mathematics					
Course Code: CSEN2102					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN2112.1. Interpret the problems that can be formulated in terms of graphs and trees.
CSEN2212.1. Explain network phenomena by using the concepts of connectivity, independent sets, cliques, matching, graph coloring etc.
CSEN2312.1. Achieve the ability to think and reason abstract mathematical definitions and ideas relating to integers through concepts of well-ordering principle, division algorithm, greatest common divisors and congruence.
CSEN2412.1. Apply counting techniques and the crucial concept of recurrence to comprehend the combinatorial aspects of algorithms.
CSEN2512.1. Analyze the logical fundamentals of basic computational concepts.
CSEN2612.1. Compare the notions of converse, contrapositive, inverse etc. in order to consolidate the comprehension of the logical subtleties involved in computational mathematics.

2. Detailed Syllabus

Module 1 [10L]
Graph Theory: Tree, Binary Tree, Spanning Tree. Walk, Path, Cycle, Hamiltonian Graph, The Travelling Salesman Problem, Euler Graph, The Chinese Postman Problem. Planar Graph, Euler's Formula for Planar Graph and Related Problems. Examples of Non-Planar Graphs. Kuratowski's Theorem. Matching and Augmenting Paths, Hall's Marriage Theorem and Related Problems. Vertex Coloring, Chromatic Polynomials.

Module 2 [10L]
Number Theory: Well Ordering Principle, Principle of Mathematical Induction, Divisibility theory and properties of divisibility, Fundamental Theorem of Arithmetic, Euclidean Algorithm for finding greatest common divisor (GCD) and some basic properties of GCD with simple examples, Congruence, Residue classes of integer modulo $n(Z_n)$ and its examples.

Module 3 [10L]
Combinatorics: Counting Techniques: Permutations and Combinations, Distinguishable and Indistinguishable Objects, Binomial Coefficients, Generation of Permutations and Combinations, Pigeon-hole Principle, Generalized Pigeon-Hole Principle, Principle of Inclusion and Exclusion, Generating Functions and Recurrence Relations: Solving Recurrence Relations Using Generating Functions and other Methods, Divide-and-Conquer Methods, Formulation and Solution of Recurrence Relations in Computer Sorting, Searching and other Application Areas.

Module 4 [12L]
Propositional Calculus: Propositions, Logical Connectives, Truth Tables, Conjunction, Disjunction, Negation, Implication, Converse, Contra positive, Inverse, Biconditional Statements, Logical Equivalence, Tautology, Normal Forms, CNF and DNF, Predicates, Universal and Existential Quantifiers, Bound and Free Variables, Examples of Propositions with Quantifiers.

3. Textbooks

1. Discrete Mathematics and its Applications, Kenneth H. Rosen, Tata McGraw- Hill.
2. Discrete Mathematics, T Veerarajan, Tata McGraw- Hill.

4. Reference Books

1. Elements of Discrete Mathematics: A Computer Oriented Approach, C L Liu and D P Mohapatra, McGraw Hill.
2. Discrete Mathematical Structure and Its Application to Computer Science, J.P. Tremblay and R. Manohar, McGraw Hill.
3. Discrete Mathematics for Computer Scientists and Mathematicians, J.L.Mott, A. Kandel and T.P.Baker, Prentice Hall
4. Discrete Mathematics,Norman L. Biggs, Seymour Lipschutz, Marc Lipson, Oxford University Press, Schaum's Outlines Series.
5. Higher Algebra (Classical), S.K. Mapa, Sarat Book Distributors.
6. Introduction to Graph Theory (2nd Ed), D G West, Prentice-Hall of India, 2006.

4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

4. Reference Books

1. Data Structures and Program Design In C, 2/E, Robert L. Kruse, Bruce P. Leung.

Course Name: Discrete Mathematics					
Course Code: CSEN2102					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN2112.1. Interpret the problems that can be formulated in terms of graphs and trees.
CSEN2212.1. Explain network phenomena by using the concepts of connectivity, independent sets, cliques, matching, graph coloring etc.
CSEN2312.1. Achieve the ability to think and reason abstract mathematical definitions and ideas relating to integers through concepts of well-ordering principle, division algorithm, greatest common divisors and congruence.
CSEN2412.1. Apply counting techniques and the crucial concept of recurrence to comprehend the combinatorial aspects of algorithms.
CSEN2512.1. Analyze the logical fundamentals of basic computational concepts.
CSEN2612.1. Compare the notions of converse, contrapositive, inverse etc. in order to consolidate the comprehension of the logical subtleties involved in computational mathematics.

2. Detailed Syllabus

Module 1 [10L]

Graph Theory: Tree, Binary Tree, Spanning Tree. Walk, Path, Cycle, Hamiltonian Graph, The Travelling Salesman Problem, Euler Graph, The Chinese Postman Problem. Planar Graph, Euler's Formula for Planar Graph and Related Problems. Examples of Non-Planar Graphs. Kuratowski's Theorem. Matching and Augmenting Paths, Hall's Marriage Theorem and Related Problems. Vertex Coloring, Chromatic Polynomials.

Module 2 [10L]

Number Theory: Well Ordering Principle, Principle of Mathematical Induction, Divisibility theory and properties of divisibility, Fundamental Theorem of Arithmetic, Euclidean Algorithm for finding greatest common divisor (GCD) and some basic properties of GCD with simple examples, Congruence, Residue classes of integer modulo $n(Z_n)$ and its examples.

Module 3 [10L]

Combinatorics: Counting Techniques: Permutations and Combinations, Distinguishable and Indistinguishable Objects, Binomial Coefficients, Generation of Permutations and Combinations, Pigeon-hole Principle, Generalized Pigeon-Hole Principle, Principle of Inclusion and Exclusion, Generating Functions and Recurrence Relations: Solving Recurrence Relations Using Generating Functions and other Methods, Divide-and-Conquer Methods, Formulation and Solution of Recurrence Relations in Computer Sorting, Searching and other Application Areas.

Module 4 [12L]

Propositional Calculus: Propositions, Logical Connectives, Truth Tables, Conjunction, Disjunction, Negation, Implication, Converse, Contra positive, Inverse, Biconditional Statements, Logical Equivalence, Tautology, Normal Forms, CNF and DNF, Predicates, Universal and Existential Quantifiers, Bound and Free Variables, Examples of Propositions with Quantifiers.

3. Textbooks

1. Discrete Mathematics and its Applications, Kenneth H. Rosen, Tata McGraw- Hill.
2. Discrete Mathematics, T Veerarajan, Tata McGraw- Hill.

4. Reference Books

1. Elements of Discrete Mathematics: A Computer Oriented Approach, C L Liu and D P Mohapatra, McGraw Hill.
2. Discrete Mathematical Structure and Its Application to Computer Science, J.P. Tremblay and R. Manohar, McGraw Hill.
3. Discrete Mathematics for Computer Scientists and Mathematicians, J.L.Mott, A. Kandel and T.P.Baker, Prentice Hall
4. Discrete Mathematics,Norman L. Biggs, Seymour Lipschutz, Marc Lipson, Oxford University Press, Schaum's Outlines Series.
5. Higher Algebra (Classical), S.K. Mapa, Sarat Book Distributors.
6. Introduction to Graph Theory (2nd Ed), D G West, Prentice-Hall of India, 2006.

Module 2 [10L]
Ethics and Ethical Values, Principles and theories of ethics, Consequential and non-consequential ethics, Egotism, Utilitarianism, Kant's theory and other non-consequential perspectives, Ethics of care, justice and fairness, rights and duties.
Ethics: Standardization, Codification, Acceptance, Application.
Types of Ethics: Ethics of rights and Duties, Ethics of Responsibility, Ethics and Moral judgment, Ethics of care
Ethics of justice and fairness, Work ethics and quality of life at work.
Professional Ethics: Ethics in Engineering Profession; moral issues and dilemmas, moral autonomy (types of inquiry), Kohlberg's theory, Gilligan's theory (consensus and controversy), Code of Professional Ethics Sample Code of ethics like ASME, ASCE. IEEE, Institute of Engineers, Indian Institute of materials management, Institute of Electronics and telecommunication engineers, Violation of Code of Ethics---conflict, causes and consequences
Engineering as social experimentation, engineers as responsible experimenters (computer ethics, weapons development), Engineers as managers, consulting engineers, engineers as experts, witnesses and advisors, moral leadership, Conflict between business demands and professional ideals, social and ethical responsibilities of technologies.
Whistle Blowing: Facts, contexts, justifications and case studies
Ethics and Industrial Law: Institutionalizing Ethics: Relevance, Application, Digression and Consequences.

Module 3 [10L]
Science, Technology and Engineering: Science, Technology and Engineering as knowledge and profession: Definition, Nature, Social Function and Practical application of science; Rapid Industrial Growth and its Consequences; Renewable and Non- renewable Resources: Definition and varieties; Energy Crisis; Industry and Industrialization; Man and Machine interaction; Impact of assembly line and automation; Technology assessment and Impact analysis; Industrial hazards and safety; Safety regulations and safety engineering; Safety responsibilities and rights; Safety and risk, risk benefit analysis and reducing risk; Technology Transfer: Definition and Types; The Indian Context.

Module 4 [6L]
Environment and Eco- friendly Technology: Human Development and Environment, Ecological Ethics/Environment ethics Depletion of Natural Resources: Environmental degradation, Pollution and Pollution Control, Eco-friendly Technology: Implementation, impact and assessment, Sustainable Development: Definition and Concept, Strategies for sustainable development, Sustainable Development: The Modern Trends, Appropriate technology movement by Schumacher and later development, Reports of Club of Rome.

3. Reference Books

1. Human Values, Tripathi, A.N., New Age International, New Delhi, 2006.
2. Classical Sociological Theory, Ritzer, G., The McGraw Hill Companies, New York,1996.
3. Postmodern Perspectives on Indian Society, Doshi, S.L., Rawat Publications, New Delhi,2008.
4. Sustainable Development, Bhatnagar, D.K., Cyber Tech Publications, New Delhi, 2008.
5. The age of Spiritual Machines, Kurzwell, R., Penguin Books, New Delhi,1999.
6. Social Problems in Modern Urban Society, Weinberg, S.K., Prentice Hall,Inc.,USA, 1970.
7. Sociology, Giddens, Anthony 2009, London: Polity Press (reprint 13th Edition).

B. LABORATORY COURSES

Course Name: Data Structure & Algorithms Lab					
Course Code: CSEN2151					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**1.5**

1. Course Outcomes

After completion of the course, students will be able to:
CSEN2151.1. To understand linear and non-linear data structures.
CSEN2251.1. To understand different types of sorting and searching techniques.
CSEN2351.1. To know how to create an application specific data structure.
CSEN2451.1. To solve the faults / errors that may appear due to wrong choice of data structure.
CSEN2551.1. To analyse reliability of different data structures in solving different problems.
CSEN2651.1. To evaluate efficiency in terms of time and space complexity, when different data structures are used to solve same problem.

2. Detailed Syllabus

Day 1: Time and Space Complexity

Lab Assignment

Create three different 10; 000 10; 000 matrices matrixOne, matrixTwo and result-Matrix, using dynamic memory allocation. Initialize matrixOne and matrixTwo by using rand() or srand() function, limit the values from 0 to 9. Multiply matrixOne and matrixTwo into resultMatrix.

While execution, open another terminal and use top command to see the usage of memory by the process. Calculate the time taken for the execution of the program.

Repeat the same exercise for 100,000 x 100,000matrices.

Home Assignment

Write a program (WAP) to check whether a matrix is i) identity, ii) diagonal. WAP to reverse the elements of an array without using any other variable.

Day 2: Array

Lab Assignment

WAP to add two polynomials using array. Minimize the memory usage as much as you can.

WAP to convert a matrix into its sparse representation (triple format). Once represented in sparse format, do not revert back to the matrix format any-more. Manipulate the sparse representation to find the transpose of the matrix (which should also be in sparse representation).

Calculate and find out whether using triple format for your example is advantageous or not.

Home Assignment

WAP to multiply two polynomials. Minimize usage of memory.

WAP to add two matrices using sparse representation. Manipulation of data should be done in sparse format.

Day 3: Singly Linked List

Lab Assignment

Write a menu driven program to implement a singly linked list with the operations:

i) create the list ii) insert any element in any given position (front, end or intermediate)
iii) delete an element from any given position (front, end or intermediate) iv)display the list

Home Assignment

Write a menu driven program to implement a singly linked list with the operations:

i) count the number of nodes ii) reverse the list

Day 4: Circular and Doubly Linked List

Lab Assignment

Write a menu driven program to implement a circular linked list with the operations:

i) create the list ii) insert any element in any given position (front, end or intermediate)
iii) delete an element from any given position (front, end or intermediate) iv)display the list

Home Assignment

Write a menu driven program to implement a doubly linked list with the operations:

i) create the list ii) insert any element in any given position (front, end or intermediate)
iii) delete an element from any given position (front, end or intermediate) iv)display the list

Day 5: Stack, Queue - with array

Lab Assignment

Write a menu driven program to implement stack, using array, with

i) push, ii) pop, iii) display, iv) exit operations.

WAP to evaluate a postfix expression.

Write a menu driven program to implement a queue, using array, with

i) insert, ii) delete, iii) display, iv) exit operations

Home Assignment

WAP to convert an infix expression to its corresponding postfix operation.

Write a menu driven program to implement a double-ended queue, using array, with the following operations:

i) insert (from front, from rear) ii) delete (from front, from rear)
iii) display iv) exit operations

Day 6: Stack, Queue - with linked list

Lab Assignment

Write a menu driven program to implement a stack, using linked list, with

i) push, ii) pop, iii) exit operations

Home Assignment

Write a menu driven program to implement a queue, using linked list, with

i) insert, ii) delete, iii) exit operations

Day 7: Circular Queue, Deque - with linked list

Lab Assignment

Write a menu driven program to implement a circular queue using linked list with
i) insert, ii) delete, iii) exit operations

Home Assignment

Write a menu driven program to implement a double-ended queue, using linked list, with the following operations:
i) insert (from front, rear), ii) delete (from front, rear), iii) exit operations

Day 8: Binary Search Tree (BST)

Lab Assignment

Write a program, which creates a binary search tree (BST). Also write the functions to insert, delete (all possible cases) and search elements from a BST.

Home Assignment

Write three functions to traverse a given BST in the following orders:
i) in-order, ii) pre-order, iii) post-order.
Display the elements while traversing.

Day 9: Searching

Lab Assignment

WAP to implement,
i) Linear Search, ii) Binary Search (iterative)
NB: As a pre-processing step, use bubble-sort to sort the elements in the search space.
WAP to generate integers from 1 to n (input parameter) in random order and guarantees that no number appears twice in the list. While the number sequence is being generated, store it in a text file.

Home Assignment

WAP to implement binary search recursively.

Day 10: Sorting

Lab Assignment

Write different functions for implementing,
i) Bubble sort, ii) Cocktail shaker sort, iii) Quick Sort.
Plot a graph of n vs. time taken, for n= 100, 1000, 10,000 and 100,000 to com-pare the performances of the sorting methods mentioned above. Use the second assignment of Day 9 to generate the data, using the given n values.

Home Assignment

Write different functions for implementing,
i) Insertion sort, ii) Merge sort.

Dr. Subhashis Majumder

Day 11: Graph Algorithms

Lab Assignment

Read a graph (consider it to be undirected) from an edge-list and store it in an adjacency list.
Use the adjacency list to run DFS algorithm on the graph and print the node labels. Detect and count the back-edges.

Home Assignment

WAP to implement BFS algorithm of a given graph (similarly as described for DFS, instead of back-edges count cross-edges).

3. Textbooks

1. Fundamentals of Data Structures of C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
2. Data Structures in C, Aaron M. Tenenbaum.
3. Data Structures, S. Lipschutz.
4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

4. Reference Books

1. Data Structures and Program Design In C, 2/E, Robert L. Kruse, Bruce P. Leung.

Course Name: Software Tools Lab					
Course Code: CSEN2152					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**1.5**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN2152.1. Understand the importance of knowing various tools to make programs more effective.
CSEN2252.1. Learn the concept and use of integrated development environment.
CSEN2352.1. Analyse the errors in a code using debugging methods in both Windows and Linux environment.
CSEN2452.1. Understand the need for version control and learn effective methods to do the same.
CSEN2552.1. Analyse a code with code coverage testing and know how to speed up execution using profiling tools.
CSEN2652.1. Demonstrate the utility of effectively using software tools to minimize memory leaks and bad memory manipulations in programs.

2. Detailed Syllabus

1. **CodeLite IDE [CodeBlock]**
   Learn to use CodeLite IDE for wrtiing C/C++ programming languages.
2. **Compiling with gcc**
   Learn all the command line options for compiling C programs in the unix environment using gcc.
3. **Git for sharing files and version control**
   Learn to setup a repository so that it can sync your local with that on the server. Learn to use cvs for version controlling.
4. **Debugging with gdb**
   gdb is the standard C/C++ debugger to debug your code. Learn to interact with gdb directly via a shell, or use a graphical interface provided by CodeLite IDE.
5. **Makefiles**
   Learn how to use makefile on Unix to properly build an executable.
6. **Code coverage testing with gcov**
   Learn about good testing using gcov to make sure the tests are exercising all the branches in the code.
7. **Runtime profiling with gprof**
   Learn about using gprof which is a very useful profiling tool for speeding up execution speed of a program: it will show where your program is spending most of its time, so one can know about the most important code to optimize.
8. **Memory profiling with valgrind**
   Learn to use valgrind which is a critical tool for helping one to find memory leaks in the program: malloc without free, accessing an array outside its bounds, etc.

3. Textbooks

1. The Definitive Guide to GCC, William von Hagen, 2nd Edition, 2006, Apress.
2. Linux Debugging and Performance Tuning: Tips and Techniques, Steve Best, Pearson Education,1st Edition, 2006.

4. Reference Books

1. Version control with Git, Jon Loeliger,1st Edition,2009, O'Reilly.
2. The Art of Debugging with GDB, DDD, and Eclipse, Norman Matloff, Peter Jay Salzman,2008.

Course Name: Digital Logic Lab					
Course Code: ECEN2154					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

1. Course Outcomes

After completion of the course, students will be able to:

ECEN2154.1. Use the concept of Boolean algebra to minimize logic expressions by the algebraic method, K-map method etc.
ECEN2254.1. Construct different Combinational circuits like Adder, Subtractor, Multiplexer, De-Multiplexer, Decoder, Encoder, etc.
ECEN2354.1. Design various types of Registers and Counters Circuits using Flip-Flops (Synchronous, Asynchronous, Irregular, Cascaded, Ring, Johnson).
ECEN2454.1. Realize different logic circuits using ICs built with various logic families.

2. Detailed Syllabus

Choose any ten experiments out of the twelve suggested next:

Syllabus of 4th Semester

A. THEORY COURSES

Course Name: Design & Analysis of Algorithms					
Course Code: CSEN2201					
Contact Hours per week:	L	T	P	Total	Credit points
	4	0	0	4	4

1. Course Outcomes

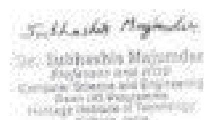
After completion of the course, students will be able to:
CSEN2211.1. Remember time complexities of various existing algorithms in different situations.
CSEN2212.1. Understand the basic principles of different paradigms of designing algorithms.
CSEN2213.1. Apply mathematical principles to solve various problems.
CSEN2214.1. Analyze the complexities of various algorithms.
CSEN2215.1. Evaluate the performance of various algorithms in best case, worst case and average case.
CSEN2216.1. Create/ Design a good algorithm for a new problem given to him/ her.

2. Detailed Syllabus

Module 1 [10L]
Algorithm Analysis: Time and space complexity. Asymptotic Notations and their significance. Asymptotic Analysis. Finding time complexity of well-known algorithms like-insertion sort, heapsort, Asymptotic solution to recurrences, Substitution Method, Recursion Tree, Master Theorem.
Divide-and-Conquer Method: Basic Principle, Binary Search – Worst-case and Average Case Analysis, Merge Sort – Time Complexity Analysis, quicksort – Worst-case and Average Case Analysis, Concept of Randomized Quicksort.
Medians and Order Statistics
Lower Bound Theory: Bounds on sorting and searching techniques**.**

Module 2 [16L]
Greedy Method: Elements of the greedy strategy. Fractional Knapsack Problem, Huffman codes.
Dynamic Programming: Basic method, use, Examples: 0-1 Knapsack Problem, Matrix-chain multiplication, LCS Problem.
Graph Algorithms: Minimum cost spanning trees: Prim's and Kruskal's algorithms and their correctness proofs (Greedy Method). Shortest Path Algorithm: Dijkstra's with correctness proof. (Greedy method), Bellman Ford with correctness proof, All pair shortest path (Floyd-Warshall Algorithm) (Dynamic Programming).

Module 3 [10L]
Amortized Analysis: Aggregate, Accounting and Potential methods.
String matching algorithms: Different techniques – Naive algorithm, string matching using finite automata, and Knuth , Morris , Pratt (KMP) algorithm with their complexities
Randomized Algorithm: Skip List.



Module 4 [10L]
Disjoint Set Manipulation: UNION-FIND with union by rank, Path compression.
Network Flow: Ford Fulkerson algorithm, Max - Flow Min - Cut theorem (Statement and Illustration)
NP-completeness: P class, NP-hard class, NP-complete class. Relative hardness of problems and polynomial time reductions. Satisfiability problem, Vertex Cover Problem, Independent Sets, Clique Decision Problem.
Approximation algorithms: Necessity of approximation scheme, performance guarantee. Approximation algorithms for 0/1 knapsack, vertex cover, TSP. Polynomial time approximation schemes: 0/1 knapsack problem.

3. Textbooks

1. Introduction to Algorithms by Cormen, Leiserson, Rivest and Stein. Third Edition, 2009. Prentice Hall.
2. Algorithm Design by Jon Kleinberg and Eva Tardos. Addison Wesley, 2005.

4. Reference Books

1. Computer Algorithms: Introduction to Design and Analysis by Sarah Basee and Allen van Gelder. 3rd Edition, Addison Wesley.

Course Name: Computer Organization and Architecture

Course Code: CSEN2202					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN1212.2. Understand the basic organization of computer and different instruction formats and addressing modes.
CSEN2212.2. Analyze the concept of pipelining, segment registers and pin diagram of CPU.
CSEN3212.2. Understand and analyze various issues related to memory hierarchy.
CSEN4212.2. Understand various modes of data transfer between CPU and I/O devices.
CSEN5212.2. Examine various inter connection structures of multi-processor.
CSEN6212.2. Design architecture with all the required properties to solve state-of-the-art problems.

2. Detailed Syllabus

Module 1 [10L]
Basics of Computer Organization: Basic organization of the stored program computer and operation sequence for execution of a program, Von Neumann & Harvard Architecture. RISC vs. CISC based architecture.
Fetch, decode and execute cycle, Concept of registers and storage, Instruction format, Instruction sets and addressing modes.
Basics of Control Unit Design - hardwired and micro programmed control, Horizontal and Vertical micro instruction.

Module 2 [11L]
Memory and I/O Organization: Memory system overview, Cache memory organizations, Techniques for reducing cache misses, Hierarchical memory technology: Inclusion, Coherence and locality properties, Virtual Memory, Memory mapped IO. Introduction to I/O interfaces. Interrupts, Interrupt hardware, Enabling and Disabling interrupts, Concept of handshaking, Polled I/O, Priorities, Daisy Chaining. Vectored interrupts; Direct memory access, DMA control.

Module 3 [10L]
Pipelined Architecture: Brief Introduction, Performance Measures - speed up, Efficiency, performance - cost ratio etc. Static pipelines - reservation tables, scheduling of static pipelines, definitions - minimum average latency, minimum achievable latency, greedy strategy etc. Theoretical results on latency bounds without proof.
Vector Processing: Vector registers; Vector Functional Units; Vector Load / Store; Vectorization; Vector operations: gather / scatter; Masking; Vector chaining.

Module 4 [9L]
SIMD Architectures: Brief introduction, various concepts illustrated by studying detailed SIMD algorithms, viz., Matrix multiplication, Sorting on Linear array.
Interconnection Networks: Detailed study of Interconnection Network - Boolean cube, Mesh, Shuffle-exchange, Banyan, Omega, Butterfly, Generalized Hypercube, Delta etc.

3. Textbooks

1. Computer Organization, 5th Edition, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, MGH.
2. Computer System Architecture, 3rd Edition, Morris M. Mano, Pearson.
3. Computer Organization and Design: The Hardware/Software interface, David A. Patterson and John L. Hennessy, 3rd Edition, Elsevier, 2005.
4. Advanced Computer Architecture and Parallel processing, Hwang & Briggs, MH.
5. Advanced Computer Architecture: Parallelism, Scalability, Programmability, Kai Hwang, McGraw-Hill.

4. Reference Books

1. Onur Mutlu's lecture materials on Computer Architecture from CMU web site: https://users.ece.cmu.edu/~omutlu/.
2. NPTEL materials on Computer Organization.

Course Name: Operating Systems					
Course Code: CSEN2203					
Contact Hours per week:	L	T	P	Total	Credit points
	3	0	0	3	3

1. Course Outcomes

After completion of the course, students will be able to:

CSEN2213.1. Develop knowledge about the importance of computer system resources and the role of operating system in their management policies and algorithms.

CSEN2213.2. Understand processes and its management policies and scheduling of processes by CPU.

CSEN2213.3. Acquire an understanding of the need of process synchronization, evaluate the requirement for process synchronization and coordination handled by operating system.

CSEN2213.4. Analyse the memory management and its allocation policies and compare different memory management approaches.

CSEN2213.5. Use system calls for managing processes, memory, file system etc.

CSEN2213.6. Be familiar with different storage management policies and storage technologies.

2. Detailed Syllabus

Module 1 [7L]

Introduction: Operating system functions, OS Architecture (Monolithic, Microkernel, Layered, Hybrid), Different types of O.S. (batch, multi-programmed, time-sharing, real-time, distributed, parallel).

System Structure: Computer system operation, Operating system structure (simple, layered, virtual machine), O/S services, System calls.

Protection & Security: Goals of protection, Domain of protection, Access matrix and its representation, Threats and system security.

Module 2 [13L]

Processes and Threads: 7 state process model, Process scheduling, Operations on processes, Inter-process communication, Threads overview, Benefits of threads, User and kernel threads.

CPU Scheduling: Scheduling criteria, Preemptive & non-preemptive scheduling, Scheduling algorithms (FCFS, SJF, RR, Priority, Multi-level queue, Multi-level feedback queue), Comparative study of the algorithms, Multi-processor scheduling.

Process Synchronization: Background, Critical section problem, Software solution – Peterson and Bakery algorithm, Synchronization hardware, Semaphores, Classical problems of synchronization.

Deadlocks: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

Module 3 [9L]

Primary Memory: Background, Physical address, Logical address, Virtual address, Contiguous memory allocation (Fixed and Variable partition), Non-contiguous memory allocation techniques (Paging, Segmentation, Segmentation with Paging), Virtual memory, Demand Paging, Performance, Page replacement algorithms (FCFS, LRU, optimal), Thrashing.

Secondary Storage: Disk structure, Disk performance, Disk scheduling (FCFS, SSTF, SCAN, C-SCAN), Boot block, Bad blocks.

Module 4 [7L]

File Systems: File concept, Access methods, Directory structure, File system structure, Allocation methods (Contiguous, Linked, Indexed), Free-space management (Bit vector, Linked list, Grouping), Directory Implementation (Linear list, Hash table), Efficiency and Performance.

I/O Management: PC Bus Structure, I/O connections, Data transfer techniques (Programmed, Interrupt driven , DMA), Bus arbitration (Daisy chain, Polling, Independent request), Blocking and non-blocking I/O, Kernel I/O subsystem (Scheduling, Buffering, Caching, Spooling and device reservation, Error handling).

3. Textbooks

1. Operating System Concepts, 10E, Silberschatz A., Galvin P. B., Gagne G., Wiley Publications.
2. Operating Systems Internals and Design Principles, 9E, Stalling W., Pearson Education.

4. Reference Books

1. Operating System: Concept & Design, Milenkovie M., McGraw Hill.
2. Operating System Design & Implementation, Tanenbaum A.S., Prentice Hall NJ.
3. Operating System Concepts, Silberschatz A., Peterson J. L., Wiley Publications.
4. Operating Systems A Concept Based Approach, Dhamdhere D.M., McGraw Hill.

Air Pollution: Structures of the atmosphere, global temperature models, Greenhouse effect, global warming; acid rain: causes, effects and control. Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution.

Module 3 [6L]
Water Pollution: Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts. Biochemical effects of heavy metals; eutrophication: source, effect and control. Water quality parameters: DO, BOD, COD. Water treatment: surface water and wastewater.

Module 4 [6L]
Land Pollution: Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal.
Noise Pollution: Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noise threshold limit value; noise pollution effects and control.

3. Textbooks

1. Basic Environmental Engineering and Elementary Biology, GourKrishna Das Mahapatra, Vikas Publishing House P. Ltd.
2. Environmental Chemistry, A. K. De, New Age International.
3. Environmental Chemistry with Green Chemistry, A. K. Das, Books and Allied P. Ltd.

4. Reference Books

1. Environmental Science, S. C. Santra, New Central Book Agency P. Ltd.
2. Fundamentals of Environment & Ecology, D. De, D. De, S. Chand & Company Ltd.

B. LABORATORY COURSES

Course Name: Design & Analysis of Algorithms Lab					
Course Code: CSEN2251					
Contact Hours per week:	L	T	P	Total	Credit points
	0	0	3	3	1.5

1. Course Outcomes

After completion of the course, students will be able to:

CSEN2251.1. Understand and Apply different types of algorithm designing paradigms like divide and conquer, greedy, dynamic programming etc.
CSEN2252.1. Realize and Apply underlying mathematical principles of algorithms in the corresponding implemented program.
CSEN2253.1. Analyse and Evaluate the performance of various algorithms by observing the actual running time and main memory consumption of the corresponding implemented programs for best case, worst case and average case input data.
CSEN2254.1. Create / Design a good algorithm for solving real life computing problems, by using various design techniques and data structures, learnt in this course.

2. Detailed Syllabus

A tentative list (non-exhaustive) of the practical topics are given below:

1. **Divide and Conquer:** Implement Quick Sort and **randomized version** of quick sort using Divide and Conquer approach. Check the running time for each of the n! combinations or input sequences of a particular set of integers to observe the best, worst and average cases.
2. **Divide and Conquer:** Implement Merge Sort using Divide and Conquer approach. Check the running time for each of the n! combinations or input sequences of a particular set of integers to observe the best, worst and average cases.
3. Implement Heapsort algorithm. Check the running time for each of the n! combination or input sequences of a particular set of integers to observe the best, worst and average cases.
4. **Dynamic Programming:** Find the minimum number of scalar multiplications needed for chain of Matrices.
5. **Dynamic Programming:** Implement Bellman Ford Algorithm to solve Single Source shortest Path problem of a graph.
6. **Dynamic Programming:** Implement Floyd- Warshall Algorithm to solve all pair Shortest path for a graph.
7. **Dynamic Programming:** Solve 0/1 Knapsack problem using dynamic problem.
8. **Dynamic Programming:** Solve Longest Common Subsequence problem using dynamic problem.
9. **Greedy method:** Implement Dijkstra's algorithm to find Minimum Spanning Tree of a graph by using minimum priority Queue or minimum heap data structure.
10. **Greedy method:** Implement Prim's algorithm to find Minimum Spanning Tree of a graph by using minimum priority Queue or minimum heap data structure.

11. **Greedy method:** Implement Kruskal's algorithm to find Minimum Spanning Tree of a graph by implementing and using various operations of Disjoint-set forest data structure.
12. **Greedy method:** Implement Huffman coding using greedy approach.
13. **Realization of Amortized Analysis:** Implement a Queue using Stacks.
14. Implement KMP algorithm for string matching
15. Implement Ford-Fulkerson algorithm to get maximum flow in a given flow network.
16. **Randomized Algorithm:** Implement Skip-List)**.**

3. Textbooks

1. Introduction to Algorithms, Cormen, Leiserson, Rivest and Stein. Third Edition, 2009. Prentice Hall.
2. Algorithm Design, Jon Kleinberg and Eva Tardos. Addison Wesley, 2005.

4. Reference Books

1. Computer Algorithms: Introduction to Design and Analysis, Sarah Basee and Allen van Gelder. 3rd Edition, Addison Wesley.

Course Name: Computer Architecture Lab					
Course Code: CSEN2252					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN2252.1. Students would be able to have adequate knowledge of basics of computer architecture.
CSEN2252.2. Students would be able to understand detailed implementation of machine instructions, their classifications and their relevance to programming paradigms.
CSEN2252.3. Students would have sufficient knowledge of design implementations of various arithmetic operations such as adder, multiplier etc.
CSEN2252.4. Students would be able to design and simulate various combinatorial and sequential logic circuits using Vivado/Xilinx.
CSEN2252.5. Students would be able to understand various memory functions.
CSEN2252.6. Students would be able to design a formal testbench from informal system requirements.

2. Detailed Syllabus

Programming using VHDL

1. All Logic Gates (Data flow and Behavioral model)
2. Half adder and half subtractor (Data flow and Behavioral Model)
3. Combinatorial Designs (Data flow and Behavioral Model)
   a. 2:1 Multiplexer
   b. 4:1 Multiplexer
   c. 3:8 Decoder
   d. Comparator
4. Full adder and full subtractor (Data flow, Behavioral and Structural Model)
5. Sequential design of flip flops (SR, JK, D, T)
6. ALU design
7. Ripple carry adder (Structural Model)
8. Adder subtractor composite unit (Structural Model)
9. 4 bit synchronous and asynchronous counters.
10. Small projects like stepper motor.

3. Textbooks

1. VHDL: Programming by Example, Douglas L. Perry, Fourth Edition, McGraw Hill.

4. Reference Books

1. Introduction to Logic Circuits & Logic Design with VHDL, LaMeres, Brock J, Springer.

11. **Greedy method:** Implement Kruskal's algorithm to find Minimum Spanning Tree of a graph by implementing and using various operations of Disjoint-set forest data structure.
12. **Greedy method:** Implement Huffman coding using greedy approach.
13. **Realization of Amortized Analysis:** Implement a Queue using Stacks.
14. Implement KMP algorithm for string matching
15. Implement Ford-Fulkerson algorithm to get maximum flow in a given flow network.
16. **Randomized Algorithm:** Implement Skip-List)**.**

3. Textbooks

1. Introduction to Algorithms, Cormen, Leiserson, Rivest and Stein. Third Edition, 2009. Prentice Hall.
2. Algorithm Design, Jon Kleinberg and Eva Tardos. Addison Wesley, 2005.

4. Reference Books

1. Computer Algorithms: Introduction to Design and Analysis, Sarah Basee and Allen van Gelder. 3rd Edition, Addison Wesley.

Course Name: Computer Architecture Lab					
Course Code: CSEN2252					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN2252.1. Students would be able to have adequate knowledge of basics of computer architecture.
CSEN2252.2. Students would be able to understand detailed implementation of machine instructions, their classifications and their relevance to programming paradigms.
CSEN2252.3. Students would have sufficient knowledge of design implementations of various arithmetic operations such as adder, multiplier etc.
CSEN2252.4. Students would be able to design and simulate various combinatorial and sequential logic circuits using Vivado/Xilinx.
CSEN2252.5. Students would be able to understand various memory functions.
CSEN2252.6. Students would be able to design a formal testbench from informal system requirements.

2. Detailed Syllabus

Programming using VHDL

1. All Logic Gates (Data flow and Behavioral model)
2. Half adder and half subtractor (Data flow and Behavioral Model)
3. Combinatorial Designs (Data flow and Behavioral Model)
   a. 2:1 Multiplexer
   b. 4:1 Multiplexer
   c. 3:8 Decoder
   d. Comparator
4. Full adder and full subtractor (Data flow, Behavioral and Structural Model)
5. Sequential design of flip flops (SR, JK, D, T)
6. ALU design
7. Ripple carry adder (Structural Model)
8. Adder subtractor composite unit (Structural Model)
9. 4 bit synchronous and asynchronous counters.
10. Small projects like stepper motor.

3. Textbooks

1. VHDL: Programming by Example, Douglas L. Perry, Fourth Edition, McGraw Hill.

4. Reference Books

1. Introduction to Logic Circuits & Logic Design with VHDL, LaMeres, Brock J, Springer.

Course Name: Operating Systems Lab					
Course Code: CSEN2253					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**1.5**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN2253.1. Understand and implement basic services and functionalities of the operating system using system calls.
CSEN2253.2. Will be able to describe and create user defined processes.
CSEN2253.3. Understand the benefits of thread over process and implement them.
CSEN2253.4. Synchronization programs using multithreading concepts.
CSEN2253.5. Use modern operating system calls and synchronization libraries in software to implement process synchronization.
CSEN2253.6. Implementation of Inter-process communication using PIPE.

2. Detailed Syllabus

1. **Shell programming:** Creating a script, making a script executable, shell syntax (variables, Conditions, control structures, functions and commands).
2. **Process:** starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
3. **Signal:** signal handling, sending signals, signal interface, signal sets.
4. **Semaphore:** programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).
5. **POSIX Threads:** programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)
6. **Inter-process communication:** pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO).

3. Textbooks

1. Your Unix The Ultimate Guide, Sumitabha Das, MH

4. Reference Books

1. Beginning Linux Programming, Neil Matthew, Richard Stones, Wrox.

Course Name: Microprocessors & Microcontroller Lab					
Course Code: AEIE2255					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

1. Course Outcomes

After completion of the course, students will be able to:

AEIE1255.2. Understand and apply different instructions of 8085 microprocessor.
AEIE2255.2. Understand and apply different instructions of 8086 microprocessor.
AEIE3255.2. Understand and apply different instructions of 8051 microcontroller.
AEIE4255.2. Interface 8085A microprocessor with different input and output devices (e.g., LEDs, seven segments displays ADC, DAC, and stepper motor etc.).
AEIE5255.2. Interface 8086A microprocessor/ 8051 microcontroller with different input and output devices (e.g., LEDs, seven segments displays ADC, DAC, and stepper motor etc).

2. Detailed Syllabus

1. Familiarization with 8085A trainer kit components with the process of storing and viewing the contents of memory as well as registers. Repeat the above all using 8085A Simulator.
2. Study of programs using basic instruction set (data transfer, load/store, arithmetic, logical) of 8085A microprocessor.
3. Programming using 8085A trainer kit/simulator for:
   a) Copying and Shifting block of memory
   b) Packing and unpacking of BCD numbers
   c) Addition/Subtraction of two 8-bit Hex numbers
   d) Addition of 16-bit Hex numbers
   e) BCD Addition
   f) Binary to ASCII conversion

Course Name: Analog Circuits					
Course Code: ECEN2101					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

1. Course Outcomes

After completion of the course, students will be able to:

ECEN2111.1. Apply the previous knowledge gathered from Basic Electrical and Basic Electronics papers.
ECEN2211.1. Understand the concepts of BJT, MOSFET and biasing techniques of BJT and MOSFET based amplifier circuits.
ECEN2311.1. Analyse frequency response of amplifier circuits.
ECEN2411.1. Design different types sinusoidal oscillators and multi-vibrator circuits.
ECEN2511.1. Construct algebraic equations-based amplifier and analog computers using OP-AMP
ECEN2611.1. Design stable high-gain amplifier circuits.

2. Detailed Syllabus

Module 1 [9L]

Basic concepts and device biasing: Analog, discrete and digital signals. Diode: piecewise-linear model, clipping and clamping operation. BJT biasing circuits, Q-point and stability.
Small Signal analysis of Amplifiers: Small signal (h-parameter and r_e model) analysis of BJT CE mode amplifier circuit (derive input impedance, output impedance, voltage gain, current gain for the amplifiers).

Module 2 [9L]

Frequency Responses of Amplifiers: Frequency response of CE mode RC-coupled amplifier; effect of external and parasitic capacitors on cut-off frequencies.
Feedback & Oscillator Circuits: Concept of feedback, Effects of negative feedback in amplifiers, Oscillators circuits: Phase-shift, Wien-Bridge, Hartley, Colpitts and crystal Oscillators.

Module 3 [7L]

Fundamentals of OPAMP: Basic building blocks of OPAMP: Differential Amplifiers, Current source and current mirror circuits. Types of differential amplifiers, AC and DC analysis of differential amplifiers; Characteristics of an ideal OPAMP.
Applications of OPAMP: Inverting and non-inverting OPAMP amplifiers, Log-antilog amplifiers, Instrumentation amplifier, Precision rectifiers, basic comparator, Schmitt Trigger.

Module 4 [7L]

Power Amplifiers: Concepts and operations of Class A, B and AB amplifiers; Calculation of DC power, AC power and efficiency of these amplifiers.
Applications Analog IC: Description of 555 Timer IC, astable and mono-stable operations using 555. Study of 78XX and 79XX voltage regulator ICs.

3. Textbooks

1. Microelectronic Circuits by Adel S. Sedra, Kenneth C. Smith.
2. Electronics Devices and Circuits by Robert L. Boylestad, Louis Nashelskey.
3. Fundamentals of Microelectronics by Behzad Razavi.
4. Integrated electronics by Jacob Millman, Christos C. Halkias.

Course Name: Digital Logic					
Course Code: ECEN2104					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

1. Course Outcomes

After completion of the course, students will be able to:

ECEN2114.1. Students will learn Binary Number system, and logic design using combinational gates.
ECEN2214.1. Students will design applications of Sequential Circuits.
ECEN2314.1. Students will design Finite State Machines.
ECEN2414.1. Students will learn Memory classifications.
ECEN2514.1. Students will learn basics of CMOS logic.
ECEN2614.1. Students will be prepared to learn various digital component design as used in VLSI applications.

2. Detailed Syllabus

Module 1 [10L]

Binary System, Boolean Algebra and Logic Gates: Data and number systems; Binary, Octal and Hexadecimal representation and their conversions, BCD, Gray codes, excess 3 codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic. Boolean algebra, De-Morgan's theorem, Various Logic gates- their truth tables and circuits, universal logic gates, Representation in SOP and POS forms, Minimization of logic expressions by algebraic method, Karnaugh-map method, Quine-McCluskey method.

Module 2 [10L]

Arithmetic Circuits: Adder circuit – Ripple Carry Adder, CLA Adder, CSA, and BCD adder, subtractor circuit.
Combinational Circuit: Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and parity Generator. Shannon's Expansion Theorem, Realization of logic functions using Mux, Parity Generators.

Module 3 [10L]

Sequential Logic: Basic memory elements, S-R, J-K, D and T Flip Flops, Sequential circuits design methodology: State table and state diagram, State Reduction Method, Circuit Excitation and Output tables, Derivation of Boolean functions, Finite State Machine Design using Sequential circuit design methodology, various types of Registers (with Parallel load, shift Registers) and Counters (asynchronous ripple counters, synchronous counters: binary, BCD, Johnson).

Module 4 [6L]

Memory Systems: Concepts and basic designs of RAM (SRAM & DRAM), ROM, EPROM, EEPROM, Programmable logic devices and gate arrays (PLAs and PLDs)
Logic families: NMOS and CMOS, their operation and specifications. Realization of basic gates using above logic families, Open collector & Tristate gates, wired-AND and bus operations.

3. Textbooks

1. Digital Logic and Computer Design, Morris M. Mano, PHI.
2. Digital Principles & Applications, 5th Edition, Leach & Malvino, Mc Graw Hill Company.
3. Modern Digital Electronics, 2nd Edition, R.P. Jain. Tata Mc Graw Hill Company Limited.
4. Digital Logic Design, Fourth Edition - Brian Holdsworth & Clive Woods.
5. Digital Integrated Electronics, H.Taub & D.Shilling, Mc Graw Hill Company Limited.

4. Reference Books

1. Digital Design: Principles and Practices: John F. Wakerly.
2. Fundamental of Digital Circuits, A. Anand Kumar, PHI.

Course Name: Human Values and Professional Ethics					
Course Code: HMTS2001					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

1. Course Outcomes

After completion of the course, students will be able to:
HMTS1101.2. Be aware of the value system and the importance of following such values at workplace.
HMTS2101.2. Learn to apply ethical theories in the decision-making process.
HMTS3101.2. Follow the ethical code of conduct as formulated by institutions and organizations.
HMTS4101.2. Implement the principles governing work ethics.
HMTS5101.2. Develop strategies to implement the principles of sustainable model of development.
HMTS6101.2. Implement ecological ethics wherever relevant and also develop eco-friendly technology.

2. Detailed Syllabus

Module 1 [10L]

Human society and the Value System: Values: Definition, Importance and application, Formation of Values: The process of Socialization, Self and the integrated personality, Morality, courage, integrity.
Types of Values: Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism; Aesthetic Values: Perception and appreciation of beauty; Organizational Values: Employee: Employer--- rights, relationships, obligations; Psychological Values: Integrated personality and mental health; Spiritual Values and their role in our everyday life; Value Spectrum for a Good Life, meaning of Good Life.
Value Crisis in Contemporary Society: Value crisis at: Individual Level, Societal Level, Cultural Level; Value Crisis management: Strategies and Case Studies.

Course Name: Software Tools Lab					
Course Code: CSEN2152					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**1.5**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN2152.1. Understand the importance of knowing various tools to make programs more effective.
CSEN2252.1. Learn the concept and use of integrated development environment.
CSEN2352.1. Analyse the errors in a code using debugging methods in both Windows and Linux environment.
CSEN2452.1. Understand the need for version control and learn effective methods to do the same.
CSEN2552.1. Analyse a code with code coverage testing and know how to speed up execution using profiling tools.
CSEN2652.1. Demonstrate the utility of effectively using software tools to minimize memory leaks and bad memory manipulations in programs.

2. Detailed Syllabus

1. **CodeLite IDE [CodeBlock]**
   Learn to use CodeLite IDE for wrting C/C++ programming languages.
2. **Compiling with gcc**
   Learn all the command line options for compiling C programs in the unix environment using gcc.
3. **Git for sharing files and version control**
   Learn to setup a repository so that it can sync your local with that on the server. Learn to use cvs for version controlling.
4. **Debugging with gdb**
   gdb is the standard C/C++ debugger to debug your code. Learn to interact with gdb directly via a shell, or use a graphical interface provided by CodeLite IDE.
5. **Makefiles**
   Learn how to use makefile on Unix to properly build an executable.
6. **Code coverage testing with gcov**
   Learn about good testing using gcov to make sure the tests are exercising all the branches in the code.
7. **Runtime profiling with gprof**
   Learn about using gprof which is a very useful profiling tool for speeding up execution speed of a program: it will show where your program is spending most of its time, so one can know about the most important code to optimize.
8. **Memory profiling with valgrind**
   Learn to use valgrind which is a critical tool for helping one to find memory leaks in the program: malloc without free, accessing an array outside its bounds, etc.

3. Textbooks

1. The Definitive Guide to GCC, William von Hagen, 2nd Edition, 2006, Apress.
2. Linux Debugging and Performance Tuning: Tips and Techniques, Steve Best, Pearson Education,1st Edition, 2006.

4. Reference Books

1. Version control with Git, Jon Loeliger,1st Edition,2009, O'Reilly.
2. The Art of Debugging with GDB, DDD, and Eclipse, Norman Matloff, Peter Jay Salzman,2008.

Course Name: Digital Logic Lab					
Course Code: ECEN2154					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

1. Course Outcomes

After completion of the course, students will be able to:

ECEN2154.1. Use the concept of Boolean algebra to minimize logic expressions by the algebraic method, K-map method etc.
ECEN2254.1. Construct different Combinational circuits like Adder, Subtractor, Multiplexer, De-Multiplexer, Decoder, Encoder, etc.
ECEN2354.1. Design various types of Registers and Counters Circuits using Flip-Flops (Synchronous, Asynchronous, Irregular, Cascaded, Ring, Johnson).
ECEN2454.1. Realize different logic circuits using ICs built with various logic families.

2. Detailed Syllabus

Choose any ten experiments out of the twelve suggested next:

1. Realization of basic gates using Universal logic gates.
2. Four-bit parity generator and comparator circuits.
3. Code conversion circuits BCD to Excess-3 & vice-versa.
4. Construction of simple 3-to-8 Decoder circuit by 2-to-4 Decoders using logic gates.
5. Design a 4-to-1 Multiplexer using logic gates and use it as a Universal logic module.
6. Realization of SR (Set Reset), JK, and D flip-flops using Universal logic gates.
7. Construction of simple arithmetic logic circuits-Adder, Subtractor.
8. Realization of Asynchronous Up/Down Counter (Count up to 7) using logic gates.
9. Realization of Synchronous Up/Down Counter (Count up to 7) using logic gates.
10. Realization of Shift Registers using logic gates (Serial in Serial out and Parallel in Serial out).
11. Construction of Serial adder circuit using a D Flip-Flop and a Full adder.
12. Design a combinational circuit for BCD to Decimal conversion to drive 7-Segment display using logic gates.

C. HONORS COURSES

Course Name: Probability and Statistical Methods					
Course Code: MATH2111					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

1. Course Outcomes

After completion of the course, students will be able to:

MATH2111.1. Articulate the axioms (laws) of probability.
MATH2211.1. Compare and contrast different interpretations of probability theory and take a stance on which might be preferred.
MATH2311.1. Formulate predictive models to tackle situations where deterministic algorithms are intractable.
MATH2411.1. Summarize data visually and numerically.
MATH2511.1. Assess data-based models.
MATH2611.1. Apply tools of formal inference.

2. Detailed Syllabus

Module 1 [10L]
Probability-I (Single variable probability distributions): Review of basic probability: Axiomatic definition, Addition and Multiplication law, Conditional probability and Bayes' Theorem, Expectation and Variance of single variable discrete and continuous distributions, Normal approximation to Binomial and Poisson Distribution, Exponential and Multinomial distribution, Moment generating and characteristic functions, Limit theorems: Markov's inequality and Chebyshev's inequality with examples.

Module 2 [10L]
Probability-II (Joint Distribution and Markov Chains): Joint distribution using joint probability mass/density function, Finding marginal pmf/pdf from joint distribution, Multiplicative property of joint pmf/pdf in case of independent random variables, Markov Chains: Introduction, Chapman-Kolmogorov equations, Classification of states, Some applications: Gambler's Ruin Problem.

Module 3 [10L]
Statistics-I: Moments, Skewness and Kurtosis, Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Covariance, Correlation and Regression, Spearman's Rank Correlation coefficient, Curve fitting: Straight line and parabolas.

Module 4 [10L]
Statistics-II: Population and Samples, The sampling distribution of mean (standard deviation known), The sampling distribution of mean (standard deviation unknown), Point and Interval estimation, Tests of Hypotheses, Null Hypotheses and Tests of Hypotheses with examples.

3. Textbooks

1. Probability and Statistics for Engineers, Richard A Johnson, Pearson Education.
2. Groundwork of Mathematical Probability and Statistics, Amritava Gupta, Academic Publishers.

4. Reference Books

1. Introduction to Probability Models, S.M. Ross, Elsevier.
2. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand and Sons.
3. An Introduction to Probability theory and its applications Vol-I, W. Feller, John Wiley and Sons.

Course Name: ENVIRONMENTAL SCIENCE					
Course Code: EVSC2016					
Contact Hours per week:	L	T	P	Total	Credit Points
	2	0	0	2	0

Course Outcomes:

The course outcomes of the subject are

1. Understand the natural environment and its relationships with human activities.
2. Characterize and analyze human impacts on the environment.
3. Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
4. Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.
5. Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.
6. Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Module 1

Socio Environmental Impact 6L

Basic ideas of environment and its component Population growth: exponential and logistic; resources; sustainable development. 3L

Concept of green chemistry, green catalyst, green solvents

Environmental disaster and social issue, environmental impact assessment, environmental audit, environmental laws and protection act of India. 3L

Module 2 6L

Air Pollution

Structures of the atmosphere, global temperature models

Green house effect, global warming; acid rain: causes, effects and control.3L

Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution. 3L

Module 3 6L

Water Pollution

Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts.

Biochemical effects of heavy metals; eutrophication: source, effect and control. 2L

Water quality parameters: DO, BOD, COD.

Water treatment: surface water and waste water. 4L

Module 4 6L

Land Pollution

Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal. 3L

Noise Pollution

Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noise threshold limit value; noise pollution effects and control. 3L

Text/Books

1. GourKrishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology, Vikas Publishing House P. Ltd.

2. A. K. De, “Environmental Chemistry”, New Age International.
3. A. K. Das, Environmental Chemistry with Green Chemistry, Books and Allied P. Ltd

References/Books

1. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd
2. D. De, D. De, Fundamentals of Environment & Ecology, S. Chand & Company Ltd.

09/08/2022

Module 2: Combinational Logic [12L]:

2.1 **Arithmetic Circuits**: Adder circuit – Ripple Carry Adder, CLA Adder, CSA, and BCD adder, subtractor circuit, Fixed point multiplication - Booth's algorithm, Fixed point division – Restoring and non-restoring algorithms.

2.2 **Combinational Circuit:** Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and parity Generator. Shannon's Expansion Theorem, Realization of logic using Mux, Parity Generators.

Module 3: Sequential Logic [10L]:

Basic memory elements, S-R, J-K, D and T Flip Flops, Sequential circuits design methodology: State table and state diagram, State Reduction Method, Circuit Excitation and Output tables, Derivation of Boolean functions; Finite State Machine Design using Sequential circuit design methodology (Mealy and Moore machine), various types of Registers (with Parallel load, shift Registers) and Counters (asynchronous ripple counters, synchronous counters: binary, BCD, Johnson)

Module 4: Memory Design and Logic Families [8L]:

4.1 **Memory Systems:** Concepts and basic designs of RAM (SRAM & DRAM), ROM, EPROM, EEPROM, Programmable logic devices and gate arrays (PLAs and PLDs)

4.2 **Logic families:** TTL, ECL, NMOS and CMOS, their operation and specifications. Realization of basic gates using above logic families, Open collector & Tristate gates, wired-AND and bus operations. 4.3 Analog digital interfacing: Different A/D and D/A conversion techniques, sample-hold units and analog multiplexers in multichannel data acquisition.

Text Books:
1. Digital Logic and Computer Design, Morris M. Mano, PHI.
2. Digital Principles & Applications, 5th Edition, Leach & Malvino, Mc Graw Hill Company
3. Modern Digital Electronics, 2nd Edition, R.P. Jain. Tata Mc Graw Hill Company Limited
4. Digital Logic Design, Fourth Edition - Brian Holdsworth & Clive Woods (free download)
5. H.Taub & D.Shilling, Digital Integrated Electronics- Mc Graw Hill Company Limited

Reference Books:
1. **Digital Design: Principles and Practices: John F. Wakerly.**
2. Fundamental of Digital Circuits, A. Anand Kumar, PHI

Subject Name:	**Human Values and Professional Ethics**				
Paper Code:	**HMTS 2001**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	**0**	**0**	**2**	**2**

Module I

Human society and the Value System
Values: Definition, Importance and application.
Formation of Values: The process of Socialization,
Self and the integrated personality
Morality, courage, integrity
Types of Values:
Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism
Aesthetic Values: Perception and appreciation of beauty
Organizational Values: Employee: Employer--- rights, relationships, obligations
Psychological Values: Integrated personality and mental health
Spiritual Values &their role in our everyday life
Value Spectrum for a Good Life, meaning of Good Life
Value Crisis in Contemporary Society

Value crisis at----
Individual Level
Societal Level
Cultural Level
Value Crisis management --- Strategies and Case Studies

Module II

Ethics and Ethical Values
Principles and theories of ethics
Consequential and non-consequential ethics
Egotism,Utilatirianism, Kant's theory and other non-consequential perspectives

Ethics of care, justice and fairness, rights and duties
Ethics-- Standardization
Codification
Acceptance
Application
Types of Ethics--- Ethics of rights and Duties
Ethics of Responsibility
Ethics and Moral judgment
Ethics of care
Ethics of justice and fairness
Work ethics and quality of life at work
Professional Ethics
Ethics in Engineering Profession;
moral issues and dilemmas, moral autonomy(types of inquiry)
Kohlberg's theory, Giligan's theory(consensus and controversy)
Code of Professional Ethics Sample Code of ethics like ASME, ASCE. IEEE,Institute of Engineers,Indian Institute of materials management, Institute of Electronics and telecommunication engineers
Violation of Code of Ethics---conflict, causes and consequences
Engineering as social experimentation, engineers as responsible experimenters (computer ethics, weapons development)
Engineers as managers, consulting engineers, engineers as experts, witnesses and advisors, moral leadership
Conflict between business demands and professional ideals
social and ethical responsibilities of technologies.
Whistle Blowing: Facts, contexts, justifications and case studies
Ethics and Industrial Law
Institutionalizing Ethics: Relevance, Application, Digression and Consequences

Module III

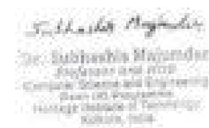
Science, Technology and Engineering
Science, Technology and Engineering as knowledge and profession
----Definition, Nature, Social Function and Practical application of science
Rapid Industrial Growth and its Consequences
Renewable and Non- renewable Resources: Definition and varieties
Energy Crisis
Industry and Industrialization

Man and Machine interaction
Impact of assembly line and automation
Technology assessment and Impact analysis
Industrial hazards and safety
Safety regulations and safety engineering
Safety responsibilities and rights
Safety and risk, risk benefit analysis and reducing risk
Technology Transfer: Definition and Types

The Indian Context

Module IV

Environment and Eco- friendly Technology
Human Development and Environment
Ecological Ethics/Environment ethics
Depletion of Natural Resources: Environmental degradation
Pollution and Pollution Control
Eco-friendly Technology: Implementation, impact and assessment
Sustainable Development: Definition and Concept Strategies for sustainable development
Sustainable Development--- The Modern Trends
Appropriate technology movement by Schumacher and later development Reports of Club of Rome.



References:

1)Tripathi,A.N., Human Values, New Age International, New Delhi,2006
2)Ritzer, G., Classical Sociological Theory, The McGraw Hill Companies, New York,1996.
3)Doshi,S.L., Postmodern Perspectives on Indian Society, Rawat Publications, New Delhi,2008.
4)Bhatnagar, D.K., Sustainable Development, Cyber Tech Publications, New Delhi, 2008.
5)Kurzwell,R., The age of Spiritual Machines, Penguin Books, New Delhi,1999.
6)Weinberg, S.K., Social Problems in Modern Urban Society, Prentice Hall,Inc.,USA, 1970.
7) Giddens, Anthony 2009. Sociology. London: Polity Press (reprint 13th Edition).

COURSE OUTCOME:

The student will

1. be aware of the value system and the importance of following such values at workplace
2. learn to apply ethical theories in the decision making process
3. follow the ethical code of conduct as formulated by institutions and organizations
4. Implement the principles governing work ethics
5. Develop strategies to implement the principles of sustainable model of development
6. Implement ecological ethics wherever relevant and also develop eco-friendly technology

Subject Name:	**Basic Environmental Engineering & Ecology**				
Paper Code:	**CHEM 2001**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module 1 9L: Environment & Ecology (General discussion)

Basic ideas of environment and its component 1L

Mathematics of population growth: exponential and logistic and associated problems, definition of resource, types of resource, renewable, non-renewable, potentially renewable, Population pyramid and Sustainable Development. 2L

General idea of ecology, ecosystem – components, types and function. 1L

Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundarban); Food chain [definition and one example of each food chain], Food web. 2L

Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphorus, Sulphur]. 2L

Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity. 1L

1. Realization of basic gates using Universal logic gates.
2. Four-bit parity generator and comparator circuits.
3. Code conversion circuits BCD to Excess-3 & vice-versa.
4. Construction of simple 3-to-8 Decoder circuit by 2-to-4 Decoders using logic gates.
5. Design a 4-to-1 Multiplexer using logic gates and use it as a Universal logic module.
6. Realization of SR (Set Reset), JK, and D flip-flops using Universal logic gates.
7. Construction of simple arithmetic logic circuits-Adder, Subtractor.
8. Realization of Asynchronous Up/Down Counter (Count up to 7) using logic gates.
9. Realization of Synchronous Up/Down Counter (Count up to 7) using logic gates.
10. Realization of Shift Registers using logic gates (Serial in Serial out and Parallel in Serial out).
11. Construction of Serial adder circuit using a D Flip-Flop and a Full adder.
12. Design a combinational circuit for BCD to Decimal conversion to drive 7-Segment display using logic gates.

C. HONORS COURSES

Course Name: Probability and Statistical Methods					
Course Code: MATH2111					
Contact Hours per week:	L	T	P	Total	Credit points
	4	0	0	4	4

1. Course Outcomes

After completion of the course, students will be able to:

MATH2111.1. Articulate the axioms (laws) of probability.
MATH2211.1. Compare and contrast different interpretations of probability theory and take a stance on which might be preferred.
MATH2311.1. Formulate predictive models to tackle situations where deterministic algorithms are intractable.
MATH2411.1. Summarize data visually and numerically.
MATH2511.1. Assess data-based models.
MATH2611.1. Apply tools of formal inference.

2. Detailed Syllabus

Module 1 [10L]

Probability-I (Single variable probability distributions): Review of basic probability: Axiomatic definition, Addition and Multiplication law, Conditional probability and Bayes' Theorem, Expectation and Variance of single variable discrete and continuous distributions, Normal approximation to Binomial and Poisson Distribution, Exponential and Multinomial distribution, Moment generating and characteristic functions, Limit theorems: Markov's inequality and Chebyshev's inequality with examples.

Module 2 [10L]

Probability-II (Joint Distribution and Markov Chains): Joint distribution using joint probability mass/density function, Finding marginal pmf/pdf from joint distribution, Multiplicative property of joint pmf/pdf in case of independent random variables, Markov Chains: Introduction, Chapman-Kolmogorov equations, Classification of states, Some applications: Gambler's Ruin Problem.

Module 3 [10L]

Statistics-I: Moments, Skewness and Kurtosis, Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Covariance, Correlation and Regression, Spearman's Rank Correlation coefficient, Curve fitting: Straight line and parabolas.

Module 4 [10L]

Statistics-II: Population and Samples, The sampling distribution of mean (standard deviation known), The sampling distribution of mean (standard deviation unknown), Point and Interval estimation, Tests of Hypotheses, Null Hypotheses and Tests of Hypotheses with examples.

3. Textbooks

1. Probability and Statistics for Engineers, Richard A Johnson, Pearson Education.
2. Groundwork of Mathematical Probability and Statistics, Amritava Gupta, Academic Publishers.

4. Reference Books

1. Introduction to Probability Models, S.M. Ross, Elsevier.
2. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand and Sons.
3. An Introduction to Probability theory and its applications Vol-I, W. Feller, John Wiley and Sons.

Course Name: ENGINEERING MECHANICS					
Course Code: MECH 2101					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

<u>Course Outcomes:</u>

After going through the course, the students will be able to

1. Describe basic concepts of vector algebra as applied to engineering mechanics.
2. Construct a free body diagram of a system under equilibrium.
3. Interpret friction phenomenon and calculate friction force.
4. Execute dynamics of members/links in a mechanism and inertia force with the help of D'Alembert's principle.
5. Develop the steps to calculate the centroid and MI values required for designing structures.
6. Implement the principles of work-energy and impulse-momentum for analysis of dynamic systems.

SL. No	Syllabus	Contacts Hrs.
Module 1	Importance of Mechanics in Engineering ; Definition of Mechanics; Concepts of particles & rigid bodies;	1
	Vector and scalar quantities; Vector algebra –definition and notation; Types of vectors – equal , equivalent , free , bound , sliding ; Addition , subtraction of vectors ; Parallelogram law , triangle law , vector polygon ; Scalar multiplication of vectors ; Resolution of vectors in Cartesian co–ordinate system ; Unit vector, unit co–ordinate vectors ($\hat{\square}$, $\hat{\square}$, $\hat{\square}$) ; Direction cosines ; Addition/ subtraction of vectors in components form. Dot product , cross product and the application ; Important vector quantities (position vector , displacement vector, velocity vector, acceleration vector, force vector);	4
	Force, Moment of a force about a point and about an axis , moment of a couple ; Representation of force and moments in items of $\hat{\square}$, $\hat{\square}$, $\hat{\square}$. Principle of transmissibility of force (sliding vector); Varignon's theorem for a system of concurrent forces with proof; Resolution of a force by its equivalent force-couple system; Resultant of forces.	5

Module 2	Type of forces – collinear, concurrent, parallel, concentrated, distributed; Active and reactive forces, different types of reaction forces; Free body concept and diagram; Concept and equilibrium of forces in two dimensions; Equations of equilibrium; Equilibrium of three concurrent forces -- Lami's theorem.	9
Module 3	Concept of friction: Laws of Coulomb's friction; Angle of friction, angle of repose, coefficient of friction -- static and kinetic. Distributed force system; Centre of gravity; Centre of mass & centroid; Centroid of an arc; Centroid of plane areas – triangle, circular sector, quadrilateral and composite area consisting of above figures. Area moment of inertia: Moment of inertia of a plane figure; Polar moment of inertia of a plane figure; Radius of gyration, Parallel axes theorem.	3 7
Module 4	Introduction to dynamics: Kinematics & kinetics; Newton's laws of motion; Law of gravitation and acceleration due to gravity; Rectilinear motion of particles with uniform & non – uniform acceleration. Plane curvilinear motion of particles: Rectangular components (projectile motion), normal and tangential components. Kinetics of particles: D'Alembert's principle and free body diagram; Principle of work & energy; Principle of conservation of energy. Impulse momentum theory: Conservation of linear momentum	3 4 3
	Total	**39 ****

Recommended books:-

1. Engineering Mechanics:- Statics and Dynamics by Meriam &Kreige , Wiley india
2. Engineering Mechanics:- Statics and Dynamics by I.H. Shames, P H I
3. Engineering Mechanics by Timoshenko , Young and Rao , TMH
4. Fundamentals of Engineering Mechanics by Nag &Chanda – ChhayaPrakashani.

09/08/2022

Course Name: FLUID MECHANICS & HYDRAULICS					
Course Code: MECH 2102					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

<u>Course Outcomes:</u>

After completion of the course, the students will be able to

1. Explain and use different properties of fluid.
2. Execute the fundamental laws to solve problems in fluid statics of incompressible fluids.
3. Relate fluid flow problems with application of fluid kinematics and dynamics principles.
4. Develop the concept of boundary layer growth and boundary layer separation.
5. Examine different flow parameters for viscous flow through pipe and judge different losses in pipe flow.
6. Formulate the steps of dimensional analysis for fluid flow problems.

Sl. No.	Syllabus	Contact Hrs.
Module 1	Definition of fluid and importance of fluid mechanics; Concept of Continuum; Fluid properties- density, specific weight, specific volume, specific gravity.	1
	Viscosity: definition, causes of viscosity, Newton's law of viscosity, Ideal and Real fluids; No-slip condition, dimensional formula and units of viscosity, kinematic viscosity; Variation of viscosity with temperature. Newtonian and Non-Newtonian fluids with Rheology diagram; Compressibility and Bulk modulus of elasticity. Difference between compressible and incompressible fluids.	4 2
	Fluid statics: Pascal's Law-statement and proof; Basic Hydrostatic Law and its proof; Variation of pressure with depth in incompressible fluid, piezometric head, pressure head; Unit and scales of pressure measurement.	3
	Measurement of fluid pressure: Piezometer, Manometers -Simple and Differential U-tube manometer, Inverted tube manometer, Inclined tube manometer. Characteristics and choice of manometric fluid.	
Module 2	Hydrostatic thrust on submerged plane and curved surfaces; buoyancy, stability of submerged and floating bodies.	5
	Fluid kinematics: Definition; Flow field and description of fluid motion (Eulerian &Lagrangian method), steady and unsteady flow, uniform and non-uniform flow-examples.	1 3
	Stream line, Stream tube, Path line; Equation of streamline and path line. Concept of control volume, Continuity equation in finite (1-D) and differential form in 3-D Cartesian coordinate system.	

Module 3	Acceleration of a fluid particle-local acceleration, convective acceleration. Fluid dynamics: Euler's equation of motion; Bernoulli's equation and its significance; Bernoulli's Equation for a real fluid with applications in flow measurement (Venturi meter, Orifice meter, Pitot tube). Application of linear momentum to control volume-linear momen analysis of force exerted by a fluid stream on a solid boundary- thrust etc. Boundary layer theory: concept of boundary layer; boundary layer thickness, displacement thickness, momentum thickness, growth of boundary layer, Boundary layer separation.	4 2 4
Module 4	Characteristics of Laminar and Turbulent flow; Reynolds experiment, critical Reynolds number; Laminar flow through pipe- Hagen-Poiseuille equation. Flow through closed conduits: Darcy Weisbach equation; concept of friction factor in a pipe flow, Variation of friction factor with Reynolds Number; Moody's diagram and its use; Minor losses- at sudden expansion, at sudden contraction, at bends, at valves, and fittings etc. Concept of flow potential and flow resistance. Pipes connected in series and parallel. Dimensional analysis and Buckingham Pi theorem.	4 4 2
	Total Classes	39

Text Books:

1. Introduction to Fluid Mechanics and Fluid Machines- Som, Biswas and Chakraborty, TMH, 3e
2. Fluid Mechanics and Machinery-C.S.P Ojha, R. Berndtsson, P.N. Chandramouli, OUP, 1e
3. Fluid Mechanics – Fox, Mcdonald& Pritchard, Wiley, 8e
4. Mechanics of Fluids- B Massey, Taylor & Francis, 8e

Reference books:

1. Fluid Mechanics – Dr. A.K. Jain, Khanna Publishers, 11e
2. Engineering Fluid Mechanics – Graebel. W. P, Taylor & Francis (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint, 2013

09/08/2022

Course Name: MACHINE DRAWING-I					
Course Code: MECH 2156					
Contact Hours per week:	L	T	P	Total	Credit Points
	0	0	3	3	1.5

Course Objectives:

After going through the course, the students will be able to

1. Interpret the conversion of Orthographic Multi-view to Isometric view and vice-versa.
2. Organize all the tools in the GUI of AutoCAD software to use it efficiently for creating a drawing.
3. Construct and modify 2D drawings using drawing and editing tools in AutoCAD software.
4. Apply tools of AutoCAD software to convert Orthographic Multi-view to Isometric view and vice-versa.
5. Implement AutoCAD software to generate Orthographic Sectional View of machine parts.
6. Create GA Assembly drawings of machine and machine parts in AutoCAD.

Module	Topics	Contact Hrs. / No. of sheets
1A	Conversion of Orthographic Projection (Hand Drawing) a) Conversion of Isometric Views into Multi-View Projection.	1 classes/1 sheet
1B	Conversion of Orthographic Projection (Hand Drawing) b) Conversion of Multi-Views into Isometric Projection.	2 classes/1 sheet
2	A detailed discussion on Drafting software (AutoCAD) Drawing format setting tools, like LIMITS Command, UNITS command, LAYER command, tool for line type setting from GUI, tool for text height-n-width setting etc. Different Drawing tools, like LINE command, PLINE command, MLINE Command, ELLIPSE Command, RECTANGLE Command, POLYGON Command etc. Different transformation and drawing editing tools, like ZOOM Command, SCALE Command, ERRASE Command, TRIM Command, OFFSET Command, MOVE Command, COPY Command, ARRAY Command etc. Conversion of Isometric Views into Multi-View Projection in AutoCAD Conversion of Multi-Views into Isometric Projection in AutoCAD	4 classes
3A	Orthographic Sectional View of a) Shaft Coupling in AutoCAD	1 ½ classes
3B	Nut & Bolt Assembly in AutoCAD	1 ½ classes
4	Assembling of Shaft with antifriction bearing mounted on a Plummer Block in AutoCAD	2 classes

Text Books:

1. Text Book of Machine Drawing, K. C. John, PHI Learning, 1e, 2009
2. Machine Drawing, K. L. Narayana, New Age International, 4e, 2012
3. IS 2079 (Guide for selection of fits), IS-919 (Recommendations for limits and fits in engineering), IS-10719 (To indicate surface texture and finish), IS-8000 (Geometrical tolerance on technical drawing)
4. AutoCAD 2013 for Engineers and Designers, Sham Tickoo, Dreamtech Press, 1e, 2013

09/02/2022

Course Name: WORKSHOP PRACTICE II					
Course Code: MECH 2157					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**1.5**

<u>Course Outcomes:</u>

After going through the course, the students will be able to:

CO1: Explain different manufacturing processes used in workshop and safety precautions to be followed during operations

CO2: Demonstrate various machining operations of Lathe and Milling machine to convert a raw material into desired product.

CO3: Distinguish between Gas Tungsten Arc Welding, Gas Metal Arc Welding and Spot Welding processes.

CO 4: Develop a wooden Pattern and Cast a component using that pattern.

CO 5: Produce a sheet metal fabricated component.

CO 6: Compare between Hot working and Cold working process and prepare a chisel from a hexagonal bar.

LIST OF JOBS TO BE CARRIED OUT

Sr. No.	Job. No.	Job Description	CO
1.	MECH 2157/01	To prepare a Job involving various operations involving Lathe machine.	1,2
2.	MECH 2157/02	To cut a spur gear in Milling machine.	1,3
3.	MECH 2157/03	To cut a key way in a shaft and spur gear(manufactured in Job no MECH 2157/02), prepare key and assemble onto the shaft.	1,2,3
4.	MECH 2157/04	To prepare a wooden pattern as per drawing given.	1,5
5.	MECH 2157/05	To prepare a sand mould using the pattern manufactured in Job No. MECH 2157/04 and cast the same.	1,5
6.	MECH 2157/06	To prepare a sheet metal fabricated component as per given drawing.	1,6
7.	MECH 2157/07	To prepare a chisel from a hexagonal bar.	1,6
8.	MECH 2157/08	To prepare a sheet metal fabricated component using TIG, MIG and SPOT Welding.	1,4

Reference books:

1. “Elements of Workshop Technology” Vol 1 &2, Hajra Choudhury, Media Promoters & Publishers Pvt. Ltd.
2. “A course in Workshop Technology” Vol 1 & 2, B. S. Raghuwanshi, Dhanpat Rai & Co.

09/02/2022

<table>
<tr><td colspan="6">Course Name: STRENGTH OF MATERIALS</td></tr>
<tr><td colspan="6">Course Code: MECH 2201</td></tr>
<tr><td rowspan="2">Contact Hours per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td><td>4</td></tr>
</table>

Course Objectives:

After going through the course, the students will be able to

1: **Define** different types of stresses / strains and **analyze** relationships among them.

2: **Classify** and **analyze** statically determinate and indeterminate problems.

3: **Examine** circular members in torsion and members subject to flexural loadings.

4: **Determine** the principal stresses and orientations of principal planes for structural members.

5: **Assess** the governing differential equation for the elastic curve of a beam.

6: **Interpret** the concept of buckling as being a kind of instability and **evaluate** columns subjected to axial loads.

Sl. No.	Syllabus	Contact Hrs.
Module 1	**Stress**: General Concepts, Method of Sections, Definition of Stress, Normal and shear stresses, Definition of strain, Normal and Shear Strains. Stress Analysis of Axially Loaded Bars: Statically Determinate and Indeterminate Problems, Thermal Stresses. Stress-Strain Relationships, Generalized Hooke's Law for isotropic materials, Poisson's ratio, relationships between Young's modulus, shear modulus and bulk modulus. Strain energy in tension, compression.	13
Module 2	**Beam Statics**: axial force, shear force & bending moment diagrams, differential equations of equilibrium for a beam element, symmetric beam bending, strain energy in bending, beams of composite cross section and shear stresses in bending. Transformation of stresses in two-dimensional problems, principal stresses, Maximum & Minimum normal stress maximum shear stresses, Mohr's circle of stress. Thin-walled pressure vessels.	13

Module 3	Beam Deflections: deflections by simple integration, method of superposition, energy methods, Castigliano's theorems. Statically determinate and indeterminate problems on beam deflections.	13
Module 4	Torsion of circular shafts, angular deflection, strain energy in torsion, torsional stress in Solid and Hollow shafts, combined bending and torsion. Columns: Buckling of columns, Critical Euler loads for columns with pinned ends and with other different end restraints, eccentric loading of short struts, Euler's curve, empirical column formulae- (i) straight line (ii) parabolic (iii) Rankine Gordon. Analysis of slender column using Johnson's Formula.	13
	Total Classes	**52**

Text Books:

1. Elements of Strength of Materials- S.P. Timoshenko & D.H. Young, East West press, 5e,2011
2. StrengthofMaterials-D.Nag &A.Chanda,WileyIndia,2e
3. StrengthofMaterials-R.Subramanian,OxfordUniversitypress,2e,2010

Reference Books:

1. Engineering Mechanics of Solids- E.P. Popov & T.A. Balan, Pearson Education Asia, 2e,2010
2. MechanicsofMaterials-R.C.Hibbeler,PrenticeHall,16e,2013
3. Introduction to Solid Mechanics by I. H. Shames, JM Pitarresi, Prentice Hall, 3e.

09/08/2022

Course Name: FLUID MACHINERY					
Course Code: MECH 2202					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completion of the course, the students will be able to

1. Select different types of fluid machines and list their components.
2. Implement the working principle of rotodynamic machines for evaluating different flow parameters.
3. Identify losses in fluid machines and relate different efficiencies.
4. Compare performance characteristics of various fluid machines.
5. Examine different components and working principles of a positive displacement machine.
6. Describe different processes and phenomena involving operation of fluid machines.

Sl. No.	Syllabus	Contact Hrs.
Module 1	Introduction: Definition and application of fluid machines. Classification under different categories (based on principle of operation, direction of energy transfer, type of fluid used). Rotodynamic Machines: Classification- Pump and Turbines. Radial, Axial and Mixed flow type machines. Centrifugal Pump: General pumping system – Suction pipe with strainer and foot valve, delivery pipe. Main components of centrifugal pump and their functions-Impeller eye, impeller blade, Volute or scroll casing, Front and Back shroud. Principle of Energy Transfer, Rotor work, Velocity diagram. Basic equation of energy transfer in Rotodynamic machines- expression for Euler head. Head vs discharge relationship: Ideal head and actual head developed. Shut-off head, manometric head, No swirl condition; effect of outlet blade angle (BCV, FCV, Radial) on head developed. Comparison of radial, axial and mixed flow pump in terms of head developed and discharge. Different losses in a centrifugal pump and efficiencies.	2 2 6
Module 2	Priming of a centrifugal pump. Characteristics curves of centrifugal pump: Main characteristics, Operating characteristics and Muschel curves. System resistance curve with expression for a general pumping system- suction head, delivery head and static head; Matching of pump and system characteristics curves. Operating point and design point. Multi staging of centrifugal pump-Series and parallel operation under different conditions. Principle of similarity in rotodynamic machine and model testing.	4 5

Module 3	Hydraulic Turbines: Classification- Impulse Turbine: Pelton Turbine- Main components and their functions, velocity triangle and work done. Wheel efficiency, Hydraulic efficiency, Overall efficiency. Reaction turbine: Radial flow reaction turbine-Francis Turbine: main components and their functions; inward and outward radial flow turbine, velocity diagram; Some definitions (Speed ratio, flow ratio, discharge). Net Head across a reaction turbine; Theory and use of different types of draft tube. Axial flow reaction turbine-Propeller and Kaplan turbines, component parts: construction and operation; Difference between Francis and Kaplan Turbine. Characteristics curves of impulse and reaction turbines: Main characteristics, Operating characteristics and Muschel curves.	4 4 2
Module 4	Positive Displacement Machine: Reciprocating Pump- Main components; Working principle- discharge, work done and power required to drive; slip of reciprocating pump. Variation of velocity and acceleration in the suction and delivery pipes due to acceleration of the piston. Effect of variation of velocity on friction in the suction and delivery pipes; Air vessel. Cavitation in Pump and Turbine: Causes and effects; NPSH, Thoma's cavitation factor and critical cavitation factor. Methods to avoid cavitation. Specific speed of pump and turbine. Unit quantities in hydraulic machines.	5 2 3
	Total Classes	39

Text Books:

1. Introduction to Fluid Mechanics and Fluid Machines-Som, Biswas and Chakraborty, TMH, 4e
2. Hydraulic Machines – Dr. Jagdish Lal, Metropolitan Book Co. Pvt. Ltd, Reprint 2011.
3. Mechanics of Fluids- B Massey, Taylor & Francis, 8e

Reference Books:

1. Fluid Mechanics and Machinery-C.S.P Ojha, R. Berndtsson, P.N. Chandramouli, OUP, 1e
2. Fluid Mechanics – J.F Douglas, J.M Gasiorek, J.A Swaffield. (Pearson 5e)
3. Fluid Mechanics – Fox, Mcdonald& Pritchard, Wiley, 8e
4. Turbomachinery- Design and theory – Gorla, Taylor & Francis (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011
5. Turbomachines by B.U.Pai; WILEY, 1e, 2013
6. Principle of Turbomachinery- Turton R. K, Springer (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011

09/08/2022

Course Name: MANUFACTURING PROCESSES					
Course Code: MECH 2204					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to

1. Explain the basic idea of different non-machining manufacturing processes.
2. Investigate different sand casting processes.
3. Compare different welding processes
4. Differentiate different forming processes & their specific applications.
5. Explain powder metallurgy process & different plastic moulding processes.
6. Describe press working process.

Sl. No.	Syllabus	Contact Hrs.
Module 1	**Introduction to casting processes:** Engineering materials (metals & plastics); classification of manufacturing processes. Casting: Definition; Ferrous &non ferrous casting; Example of cast products. Types of casting & their application: (1) Sand casting, (2) Shell moulding, (3) Expendable mould, (4) Investment casting, (5) Die casting, (6) Centrifugal casting, (7) Sodium silicate-CO_2moulding. Sand casting: pattern, types of pattern, materials, allowances, mould making procedure; definition & meaning of different terms, cope & drag, gating system and riser design. Properties of moulding sand: moulding sand composition; effect of grain size, clay & water content on moulding sand properties, sand testing. Core: Definition & use; Core making with oven/no baking, core prints & chaplets. Defects in sand casting & remedies. Process & utility of die casting & centrifugal casting.	10

Module 2	**Welding process:** Different metal welding processes; types of joints. Gas welding: oxy-acetylene flame; gas welding equipment; welding process. Electric arc welding: principle of arc formation; arc welding equipment- AC & DC machine; electrodes. Manual metal arc welding procedure: edge preparation, current & voltage setting, electrode movement; down hand, horizontal & overhead welding. TIG & MIG welding: process & application. Resistance welding- spot welding & butt/seam welding. Causes & remedy of welding defects,NDT methods.	10
Module 3	**Forming process:** Elastic & plastic deformation of perfect crystal; effect of mechanical working on mechanical properties; hot & cold working; recrystalization process. **Forging:** Definition; hot & cold forging; application. Forging methods: smith forging, drop forging, press forging & machine forging. Design features of forging dies; forging defects. **Rolling:** definition; hot & cold rolling; rolled products- sections & flats, Rolling load & torque. Rolling stand: 2 Hi, 3Hi, 4Hi & cluster mill. **Extrusion:** process & product; hot & cold extrusion; forward & backward extrusion; impact extrusion. **Wire drawing:** process & products; drawing dies, drawing machine.	10

Module 4	**Press work, Powder metallurgy & Plastic processing:** **Press work:** definition of process & different operations like shearing, blanking, piercing, notching, drawing (cupping), coining & embossing. Press tools (die & punch); effect of tool clearance; simple, compound & combination die. Basic components of a press; electro mechanical & hydraulic press. **Powder metallurgy:** Definition & products; metal powder making processes. Processing methods:blending, compacting, sintering, secondary operations (heat treatment, coating). **Definitions of polymer;** thermo-plastics & thermo-sets; popular plastics & their use. Processes:extrusion; injection moulding; blow moulding; thermo-forming (vacuum & pressure).	9
	Total Class	**39**

Text Books:

1. Manufacturing technology, Foundry, Forming & Welding-P.N Rao. Vol. 1, 3e, 2012
2. Manufacturing Science-A Ghosh & A Mallick, 2e, 2010
3. Manufacturing Engineering & Technology-S Kalpakjian; Pub:Addison Wesley. 5e, 2013
4. Fundamentals of Metal forming processes by B. L. Juneja, New age International publishers, 2e, 2010

Reference Books:

1. Materials & processes in manufacturing-E.P Degarmo, Black &Kohser, Pub: Wiley, 10e
2. Processes & materials of manufacturing-R.A Lindberg, 2e, 1978

09/08/2022

Course Name: KINEMATICS OF MACHINES					
Course Code: MECH 2205					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of this course student will be able to-

1. Specify a mechanism on the basis of its technical parameters.
2. Analyze velocity of different components in a mechanism.
3. Analyze acceleration of different components in a mechanism.
4. Synthesize principle dimensions (link length, angular position etc) of a Four Bar mechanism.
5. Construct different power transmission layout using gears.
6. Design layouts of a cam drive for specified follower motion.

Module	Syllabus	Contact Hrs.
1	Introduction to mechanisms, Difference between Machine and Mechanism; Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom (Mobility), Kutzbach criterion, Grubler's criterion. Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions.	9
2A	**Velocity Analysis of mechanisms (mechanisms up to 6 links).** Velocity analysis by instantaneous center of rotation method (Graphical approach) Velocity analysis by relative velocity method (Graphical approach)	5
2B	**Acceleration analysis of Mechanism** Acceleration Images, Klein's construction, Coriolis acceleration. Analytical expression of velocity & acceleration.	5
3A	**Synthesis** Introduction, Analytical derivation of four bar mechanism: Displacement function, velocity function and acceleration function. Analytical and Graphical process of synthesis (basic discussion) Analytical synthesis of mechanism: Function generation	3
3B	**Gear and Gear trains :** Types of Gears, Gear terminologies, Simple, compound, Epicyclic gear train; Speed-torque analysis of geartrains. gear train; Speed-torque analysis of geartrains.	6

4A	**Cam Mechanisms:** Cam and its Classifications. Followers and its Classification. Motion analysis and plotting of displacement-time, velocity-time, acceleration-time, jerk-time graphs for SHM motion, uniform velocity motion, Constant acceleration motion and Cycloid motions of cams with knife-edge, roller and flat face follower (along with concept of offset follower). Pressure angle and method to control pressure angle Layout of cam profiles.	7
4B	**Lower Pair Mechanisms:** **Straight line generating Mechanisms:** Exact Straight Line Generating Mechanisms – Peaucellier's and Hart's Approximate Straight Line Generating Mechanisms – Watt's, Grasshopper and Tchebicheff's. **Offset slider crank mechanisms-** Pantograph. Hook joint- single and double **Steering gear mechanisms –** Ackerman, Davis	4
	Total Classes	**39**

Text Books:

1. Theory of Machines – S S Rattan, Tata McGraw Hill, 4e, 2014

2. Theory of Machines – R. S. Khurmi and J. K. Gupta, S. Chand Technical, 14e, 2005

Reference Books:

1. Theory of Machines and Mechanisms – Uicker, Pennock and Shigley, Oxford University Press, 3e, 2009
2. Kinematics and Dynamics of Machinery – R. L. Norton, McGraw Hill Education, 1e, 2009
3. The Theory of Machines through Solved Problems – J. S. Rao, New Age International Publication, 1e, 2012
4. Mechanism and Machine Theory – Ashok G. Ambekar, PHI Learning, 1e, 2007
5. Theory of Mechanisms & Machines (3rd edition) By Ghosh and Mallik; East West Press, 3e, 2006

09/08/2022

Course Name: MECHANICAL MEASUREMENT AND INSTRUMENTATION					
Course Code: MECH 2211					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to

1. Classify various measuring techniques.
2. Implement the concept of interchangeability, fits and tolerance in engineering drawings and manufacturing.
3. Demonstrate the structure and characteristics of measuring instruments.
4. Define and understand the working principle of transducers.
5. Apply the knowledge of surface finish and its measurement for design of engineering components.
6. Select and operate measuring instruments such as LVDT, SEM, Strain Gauge, Piezoelectric load cell, Pneumatic gauge, Thermocouple, Optical Pyrometer as necessitated by the engineering application.

Module No.	Syllabus	Contact hrs.
1	Introduction: Definition and importance of Metrology & Measurement; Methods of measurements – direct, indirect, comparison, substitution, transposition, deflection and null measurement; Errors in measurement – absolute, relative, parallax, alignment, loading, dynamic and calibration error; Units of measurements – SI base and derived units, SI prefixes of units.	**3**
	Linear Metrology: Vernier scale; use of Vernier calliper, Vernier height and depth gauge, micrometer; slip gauge, surface plate.	**1**
	Angular Metrology: Use of protractor, Vernier bevel protractor, angle gauges, sine bar and slip gauges.	**2**
	Measurements of: (i) Level using spirit-level; (ii) Flatness using interferrometry (Newton's rings) and dial indicator; Parallelism, cylindricity and concentricity using dial indicator. Alignment & testing methods. Gear tooth measurement.	**4**
2	Interchangeability of components; concept of limits, tolerances and fits; Hole basis and shaft basis system of fits; Go and No Go limit gauges; plug, ring, snap, thread, radius and feeler gauges.	**5**
	Definition, use and essential features of Comparators; working principle and application of (i) dial gauge, (ii) Cook optical comparator, (iii) back pressure Bourdon gauge pneumatic comparator, (iv) In-process gauging (v) optical comparator-profile projector.	**5**

3	Measuring Instruments: Functional elements of an instrument – sensing, conversion & manipulation, data transmission and presentation element; Characteristics – accuracy, precision, repeatability, sensitivity, reproducibility, linearity, threshold, response; Transducers – definition, primary and secondary, active and passive. Tolerance analysis in manufacturing and assembly.	**5**
	Measurement of Surface Finish: Definition; Terminologies – geometrical surface, effective surface, surface roughness, roughness (primary texture), waviness (secondary texture), form, lay, sampling length; Numerical evaluation of surface roughness: peak-to-valley height (Rmax), centre line average (CLA, Ra), average depth (Rm), smoothness value (G); Principle of operation of a Talysurf.	**4**
4	Principle of operation of a few measuring instruments: displacement by LVDT; SEM, force by strain – gauge load cell and piezoelectric load cell; pressure by Bourdon – tube gauge; temperature by liquid-in-glass thermometer, thermocouples, optical pyrometer.	**10**
	Total:	**39**

Text Books:
1. N. V. Raghavendra & L. Krishnamurthy, Engineering Metrology & Measurement, Oxford University Press
2. R. Rajendra, Principles of Engineering Metrology, Jaico Pub. House. 2e
3. Bewoor and Kulkarni, Metrology & Measurement, TMH. 1e

Reference books:
1. E.O. Doebelin and D.N. Manik, Measurement Systems– Application and Design, Tata McGraw Hill. 5e
2. Beckwith, Lienhard and Marangoni, Mechanical Measurements, Pearson. 6e
3. R.K. Jain, Metrology, Khanna Publication, New Delhi. 20e

09/08/2022

Course Name: FLUID MECHANICS & HYDRAULIC MACHINES LAB					
Course Code: MECH 2252					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**1.5**

Course Outcomes:

At the end of the course, a student will be able to

CO 1 Identify different flow patterns and regimes.

CO 2 Appraise Coefficient of Discharge of Flow Measuring Devices.

CO 3 Explain the determination of airflow velocity by a Pitot Static Tube.

CO 4 Examine the validity of Bernoulli's equation for steady flow of water in a tapered duct.

CO 5 Demonstrate practical understanding of friction losses in internal pipe flow.

CO 6 Judge the overall efficiencies of Pelton turbine, Francis Turbine and Centrifugal pump.

List of Experiments / Jobs to be carried out during the semester

1. Characteristics of Laminar & Turbulent flow.
2. Verification of Bernoulli's Equation.
3. Determination of Coefficient of Discharge of Flow Measuring Devices in pipe flow.
4. Pipe friction characteristics in different flow regimes for flow through pipes.
5. Determination of Coefficient of Discharge of V-Notch & Rectangular Weir.
6. Determination of airflow velocity by a Pitot Static Tube.
7. Performance test of a Centrifugal Pump.
8. Performance test of a Pelton Turbine.
9. Performance test of a Francis Turbine.

Reference Books:

1. 'Fluid Mechanics with Laboratory Manual' by B. Majumdar, PHI Publication.

2. 'Fluid Mechanics' by Frank M White, McGraw-Hill Publication.

3. 'Mechanics of Fluids' by B. Massey, CRC Press Publication.

4. 'Fluid Mechanics (Including Hydraulic Machines)' by A. K. Jain, Khanna Publication.

09/08/2022

Course Name: MECHANICAL MEASUREMENT AND INSTRUMENTATION LAB					
Course Code: MECH 2261					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to

1 Measure linear dimensions using Vernier Caliper, Outside Micrometer. Vernier Height Gauge & Depth Micrometer.

2 Test internal dimensions using Inside Tubular Micrometer and Telescopic Gauge.

3 Measure precision angles using Sine Bar, Vernier Bevel Protractor and Angle Gauge.

4 Check linear and angular dimensions of precision components and profiles using Profile Projector.

5 Identify parallelism, cylindricity and concentricity of components using dial indicator.

6 Compare surface finish.

Taking measurements using following instruments:

1. Measurement of linear dimensions of a rectangular block by Vernier Caliper and Outside Micrometer.
2. Measurement of the diameter of a hole by Inside Tubuler Micrometer and Telescopic Gauge.
3. Linear measurement using Vernier Height Gauge & Depth Micrometer.
4. Precision Angular measurement using Sine Bar.
5. Angular measurement using Vernier Bevel Protractor and Angle Gauge.
6. Measurement of thread profile of a bolt/ file by Profile Projector.
7. Measurement using Thread gauge, Radius gauge, Angle gauge and Feeler gauge.
8. Measurement of parallelism, cylindricity and concentricity of components using dial indicator.
9. Measurement of surface finish
10. Measurement of air velocity across an air duct using anemometer.

N.B. A minimum of six experiments must be performed in the semester.

Text Books:

1. N. V. Raghavendra & L. Krishnamurthy, Engineering Metrology & Measurement, Oxford University Press

2. R. Rajendra, Principles of Engineering Metrology, Jaico Pub. House. 2e

3. Bewoor and Kulkarni, Metrology & Measurement, TMH. 1e

09/08/2022

Course Name: ENGINEERING THERMODYNAMICS					
Course Code: MECH 2203					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

<u>Course Outcomes:</u>

After going through the course, the students will be able to

1. Analyze a thermodynamic system and calculate work transfer in various quasi-static processes.
2. Understand the difference and correlation between heat transfer and work transfer
3. Read and interpret the values of properties of water/steam from steam table for evaluation of heat transfer and work transfer in processes involving steam
4. Understand and calculate the change of entropy for some specific cases
5. Calculate thermal efficiency of Otto, Diesel and dual combustion cycle
6. Understand the basics of thermal power generation and calculate the efficiencies of Rankine cycles with reheat and regeneration.

Sl. No.	Syllabus	Contact Hrs
Module 1	**Basic concepts of Thermodynamics:** Introduction; Definition of Thermodynamic systems; System boundary, universe; Open, closed and isolated systems; Control mass and control volume; State; Definition of properties: intensive, extensive & specific properties. Thermodynamic equilibrium; Change of state; Thermodynamic processes; Quasi-static processes; Thermodynamic cycles; Zeroth law of Thermodynamics -concept of temperature.	5
	Heat & Work: Definition and units of Thermodynamic work; Work transfer-displacement work for a simple compressible system, path function, Pdv work in various quasi-static processes(isothermal, isobaric, adiabatic, polytropic, isochoric); Free expansion; Net work done by a system in a cycle. Definition and unit of heat; Heat transfer-a path function; Similarities and dissimilarities between heat and work.	4
	First law of Thermodynamics: For a closed system executing a cycle; Concept of stored energy; Energy as a property, different forms of stored energy, internal energy, first law for a non-flow process;	3

Module 2	Definition of enthalpy, C_p, C_v; Energy of an isolated system; Flow energy; First law for an open system-steady flow energy equation; Examples of steady flow devices (nozzle and diffuser, turbine, pump, compressor, heat exchanger, throttling device); PMM-I.	4
	Pure substance: Definition, properties of pure substance; Phases of pure substance; Phase change processes of pure substances — critical point, triple point; Property (phase) diagrams — P- v, P- T, T- s, h-s diagrams; P v T surface for water; Property tables of pure substances — compressed liquid, saturated, wet and superheated vapour, use of saturated and superheated steam table and Mollier diagram.	7
Module 3	**Second law of Thermodynamics:** Qualitative difference between heat and work; Definition of source & sink: cyclic heat engine, heat pump and refrigerator, thermal efficiency of heat engine, C.O.P of heat pump and refrigerator; Kelvin-Plank and Clausius statements of second law; Equivalence of the two statements. PMM-II	3
	Reversible process; Irreversible process; Factors for irreversibility; Carnot cycle and Carnot efficiency; Carnot theorem, corollaries; Thermodynamic temperature scale; Reversible heat engine and heat pump.	3
	Entropy: Clausius Inequality; Entropy as a property; T-s plot for reversible isothermal, adiabatic, isochoric & isobaric processes. Tds equation and calculation of entropy change of ideal gases for various processes; entropy change of solids; Concept and uses of entropy, Entropy principle.	5
Module 4	**Air standard Cycles and introduction to I C Engines:** Air standard cycles — Otto cycle, Diesel cycle, Dual combustion cycle; P-v, T-s plots; Efficiency, net work done, mean effective pressure; Principles of 4-stroke S I engine and C I engine; Engine nomenclature.	4
	Reciprocating air compressor: Compression process, work of compression, Single stage reciprocating compressor, volumetric efficiency, efficiency of a compressor; Multistage compression, advantages, ideal intermediate pressure.	5
	Vapour power Cycle: Carnot cycle and its practical difficulties; Basic Rankine cycle with steam; Mean temperature of heat addition, steam rate, heat rate; Reheat cycle; Regenerative cycle.	5
		48

Text Books:

1. Engineering Thermodynamics- 5e, Nag, P.K. – TMH.
2. Fundamentals of Thermodynamics- 6e, Sonntag, Borgnakke& Van Wylen, Wiley India

Reference Books:

1. Thermodynamics- an Engineering approach - 6e, Cengel& Boles, TMH
2. Principles of Engineering Thermodynamics -7e, Moran, Shapiro, Boettner, Bailey. Wiley India

09/08/2012

Course Name: APPLIED MECHANICS LAB					
Course Code: MECH 2251					
Contact Hours per week:	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Outcomes:

After completing the course students will be able to:

1. Examine material behavior under different loading conditions experimentally and relate with theoretical knowledge gained.
2. Demonstrate experimentally the load-deformation behavior of a material under tensile and torsional loadings.
3. Utilize a strain gauge for measurement of strain and subsequently the modulus of elasticity.
4. Evaluate hardness using different hardness test method and coefficient of friction between different materials.
5. Explain the method deployed in determining the stiffness of leaf and helical spring.
6. Identify metal cracks and examine metallographic structure.

List of Experiments:

1. Tensile test of a mild steel specimen.
2. Impact Test – Charpy and Izod.
3. Drawability test of sheet metal by Cupping
4. Fatigue test of a typical sample.
5. Torsion test of a mild steel specimen.
6. Deflection of cantilever beam using a strain gauge.
7. Hardness Test (Brinell hardness, Rockwell hardness and Vicker's hardness).
8. Determination of coefficient of friction.
9. Determination of stiffness of a leaf spring.
10. Determination of stiffness of a close coiled helical spring.
11. Identification of surface cracks by Dye Penetration Test of given sample.
12. Identification of surface and sub-surface cracks by Magnetic particle inspection (MPI) Test.
13. Sample preparation and metallographic observation of ferrous, non-ferrous metals and alloys.

Reference Books:

1. Nag, D., Chanda, A. (2018) Strength of Materials, Second Edition, Wiley India Pvt. Ltd., New Delhi, India.
2. Timoshenko, S.P., Young, D.H. (2011) Elements of Strength of Materials, Fifth Edition, Rekha Printers Pvt. Ltd., Affiliated by East West Press Pvt. Ltd., New Delhi, India.
3. Hibbeler, R.C. (2018) Mechanics of Materials, Ninth Edition (S.I. units), Pearson India Education Services Pvt. Ltd., Noida, India.
4. Bhandari, V.B. (2015) Design of Machine Elements, Third Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi, India.

Course Name: MACHINE DRAWING-II					
Course Code: MECH 2256					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**1.5**

<u>Course Outcomes:</u>

On completion of this course students will be able to

1. Inspect manufacturing drawing of machine and machine parts containing various tolerancing symbols and manufacturing symbols.
2. Develop a 3-D model of any machine part parametrically in the simplest possible way using a CAD software.
3. Utilize efficiently advanced modeling tools of a CAD software to create complicated parts.
4. Inspect modeling and drafting of any product along with its all required symbols and dimensions .
5. Assess the correctness of a modeling job from its manufacturing viability point of view.
6. Create 3D-model of any machine assembly using a CAD software starting from part modeling to automated drafting along with BOM.

Module	Topics	Contact Hrs. / No. of sheets
1	● **Geometric dimensioning and tolerancing (GD&T):** □ An introduction about GD&T □ Discussion on analytical methodology to calculate Dimensional Tolerances on the basis of required fitment and basic dimensions. □ To know how to select any Geometrical Tolerance on the basis positional requirements of different parts in an assembly. □ Different types of surface roughness symbols and manufacturing symbols and their implementations. ● **A brief discussion on CAD/CAM/CAE and their respective software.**	9
2	● **3D modeling tools of a CAD software named *PTC Creo-Parametric*:** □ Discussion on tools used in 'Sketching Module' of PTC Creo. □ Different Sketch based tools under 'Part Module' like, Extrude, Revolve, Sweep, Variable Section Sweep, Blend, and Swept Blend. □ Various Feature based tools under Part Module like, Round, Chamfer, Pattern, Hole, Copy Geometry, Boolean Operations (Trim, Merge and Intersect), Thicken and Solidify.	12
3	● **Assembly of parts with PTC Creo Parametric Software:** □ Discussion on Top-Down assembly methodology □ Creation of assembled part using Bottom-Up methodology □ Exploding the components of an assembled part. ● **Automated Drafting using PTC Creo Parametric** □ Setting of different drafting parameters. □ Creation of different projections, auxiliary projection, sectional view, detailed view. □ Dimensioning, writing annotations, putting tolerance symbols, surface finish symbols and manufacturing symbols.	9
4	Building up parts, assembly model and manufacturing drawing of following machine part assemblies in accordance with few predefined design constraints. □ A screw jack assembly. □ A shaft coupling assembly.	6

Recommended Book:

1. PTC Creo Parametric 3.0- for engineers and Designers by Prof. Sham Tickoo, Dreamtech Press

09/08/2022

Course Name : Chemistry of Biomolecules					
Course Code: BIOT2101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Course Outcomes:
After completion of this course, the students will be able to:

1. Calculate the pH of a buffer system, identify different stereoisomer's of carbohydrate and lipids and understood the chemistry of carbohydrate and lipids.
2. Explain the different structural components and physiochemical properties of amino acids, proteins.
3. Analyses and explain the different structural components and physiochemical properties of DNA and RNA.
4. Select and apply suitable spectroscopic techniques for estimation biomolecules.
5. Select and apply suitable techniques for and structure determination of of biomolecules.
6. Able to solve mathematical problems related to estimation and structural features of biomolecules.

Module –I: Introduction and Chemistry of Carbohydrates [10L]

Introduction: Structure of water molecules, Weak inter-molecular interactions in biomacromolecules, Basic concepts of pH, buffer, pKa**.** Chemistry of Carbohydrates: Definition, classification, structure and chemical properties of: Monosaccarides; Sucrose, Lactose, Maltose; Glucosamine, Muramic Acid; Starch, Glycogen, Cellulose, Chitin, Agar, Proteoglycans; Sialic acids and blood group polysaccharides. Stereochemistry of Carbohydrates: Projection formula (Fischer, flying-wedge, Sawhorse, Newman & Howarth), Configuration, conformation, Optical isomerism (d/l, D/L and R/S nomenclature), Anomer, Epimer, Mutarotation.

Module-II: Chemistry of Lipids [10L]

Lipids: Definition, classification. Structure, Reactions and characterization of: fatty acids, Triacyl glycerols. Structure of Prostaglandins, Oil, Wax. Geometrical isomerism (cis/trans, syn/anti, E/Z) of Fatty acids. Hydrolysis, saponification value, iodine number, rancidity and Biological significance of fats. Phospholipids: Introduction and importance. Glycerophospholipids, lecithins, cephalins, phosphatidyl serine, phosphatidyl inositol, plasmalogens, sphingomyelines. Glycolipids: cerbrosides, gangliosides. Steroids and carotenoids: Introduction, and importance, cholesterol, modifications of sterols, bile acids, steroid hormones, carotenes.

Module-III: Chemistry of Amino Acids, Proteins and Nucleic acids [10L]

Classification, Structure, pH titration curve and Important Chemical reactions. Structure of Amino Acids. Peptide bond, Solid phase peptide synthesis, peptide sequencing. Four levels structures, Conformation (Ramachandran plot, domains, motif and folds), Separation Methods based on structure and chemical properties; denaturation and renaturation of proteins. Example: RNaseA, keratins, collagen, Lectins, myoglobin, hemoglobin. Stability of protein. Chemistry of Nucleic Acids: Structure, nomenclature of Nucleoside, Nucleotides. Four levels structures, Functions, Conformations, Nucleotide sequence composition of DNA and RNA. Supercoiled structure, Denaturation and renaturation kinetics of DNA. Stability of Nucleic acids

Module-IV: Techniques for estimation and structure determination of Biomolecules [10L]

Introduction to absorption and emission spectroscopy and Lambert–Beer law**.** Estimation of biomolecules by spectroscopic, colorimetric, phosphorescence, and luminescence method. Basic concepts and principles for structure determination techniques: X-ray diffraction, crystallography; spectroscopy: UV and visible, fluorescence, Infrared, Nuclear Magnetic Resonance, circular dichroism, Optical Rotatory Dispersion, Surface plasmon resonance, Electron Spin Resonance Spetroscopy, Microscopy: atomic force (AFM) and cryoelectron. Radioisotopic techniques.

Textbooks:

1. Lehninger Principles of Biochemistry by Nelson and Cox, McMillan publishers
2. Van Holde, Principles of Physical Biochemistry, Pearson
3. Biochemistry,by 4^{th} Edn. (2011) Voet, D. and Voet JG. (Wiley)
4. Biochemical Calculations by Irwin H. Segel, John Wiley & Sons

Reference books:

1. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY
2. Biochemistry by Zubey. Wm. C. Brown publishers
3. Organic Chemistry, Finar, IL. Part II.
4. Biochemistry, 5th edition (2002) by Berg, Tymoczko, and Stryer. (W H Freeman)
5. David Friefelder, Physical Biochemistry
6. Practical Biochemistry Principles and techniques :Ed Wilson and Walker, Cambridge University Press
7. Physical Chemistry, Principles and Applications in Biological Sciences (2001) by Tinoco, Sauer and Wang,, Prentice Hall, 4th Edition
8. Physical Chemistry for the Life Sciences (2005) by Atkins,, W.H. Freeman
9. Physical Chemistry with Applications to the Life Sciences(1979) by Eisenberg & Crothers, Benjamin/Cummings Publishing Co.
10. Principles of Physical Biochemistry (1998) by K. E. van Holde, W. C. Johnson, and P.S. Ho.
11. Biophysical Chemistry (1981), Part I: The Conformation of Biological Macromolecules, Part II: Techniques for the Study of Biological Structure and Function by C.R. Cantor and P.R.Schimmel.

Srabanti Basu

Course Name : Industrial Stoichiometry					
Course Code: BIOT2102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

After completion of this course, the students will be able to:

1. Solve problems related to units and conversions and fit the given data using the methodologies.
2. Able to make material balances on unit operations and processes.
3. Understand stoichiometry of microbial growth and product formation.
4. Solve problems related to energy balance for steady state processes.
5. Determine the heat of reaction for processes with biomass and secondary metabolite production.
6. Design simultaneous material and energy balances in biochemical processes

Module-I: Units and Dimensions [10L]

Small units and dimensions, dimensionless groups, dimensional analysis. Conversion of equations. Use of log-log and semi-log graph paper, graphical differentiation and graphical integration, treatment and interpretation of data by least square analysis.

Module II: Material balance [10L]

Introductory Concepts- simplification of the general mass balance equation for steady and unsteady state processes, procedure for material balance calculations, material balance without chemical reactions: application of humidification, distillation column. Material balance with chemical reaction: combustion.

Stoichiometry of growth and product formation- growth stoichiometry and elemental balances. Material Balance with recycle, bypass and purge streams in bioprocess.

Module-III: Energy Balance [10L]

General energy balance equation for steady state processes - without and with chemical reaction. Enthalpy calculation procedures: enthalpy change due to reaction, heat of combustion, heat of reaction for chemical processes.

Energy-balance equation for cell culture -heat of reaction for processes with biomass and secondary metabolites production in fermentation processes.

Module-IV: Combined material and energy balance in bioprocesses [10L]

Simultaneous material and energy balances in biochemical processes: growth associated, non-growth associated and mixed growth associated product production process.

Srabanti Basu

Textbook:

1. Bhatt & Vora, Stoichiometry, 4th Ed., Tata McGraw Hill

Reference books:

1. Hougen and Watson, Chemical Process Principles (Part one): 2nd ed, John Wiley.
2. Basic Principles and Calculations in Chemical Engineering: Himmelblau, 6th Ed. Prentice Hall India.
3. Bioprocess Engineering: 2nd edition, Michael L. Shuler, Filkert Kargi. Prentice Hall India.

<table>
<tr><td colspan="6">Course Name : Biochemistry</td></tr>
<tr><td colspan="6">Course Code: BIOT2103</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td><td>4</td></tr>
</table>

Course Outcomes

After completion of this course, the students will be able to:

1) Explain the basic concepts of enzymes.
2) Understand and apply mathematical knowledge to solve Enzymatic Kinetics particularly related to Michaelis-Menton Equation.
3) Understand and grasp knowledge about main principles behind how various cell signalling works.
4) Explain the basic concepts of how extracellular matrix works.
5) Explain the basis behind lipid synthesis and lipid β oxidation pathways.
6) Understand how Cholesterol synthesis happens.

Module-I: Introduction to Enzyme & Carbohydrate Metabolism [10L]

Enzymes: Basic concept of enzyme-substrate reaction, Classification and nomenclature, active site, allosteric regulation. **Metabolism of carbohydrates and their regulation:** glycolysis, TCA cycle, pentose phosphate pathway, Glyoxalate cycle, Cori cycle, glucuronate pathway**,** glycogenolysis, gluconeogenesis glycogenesis. **Oxidative phosphorylation:** electron transport chain, ATP synthesis, and its regulation. **Photosynthesis:** Photophosrylation, Calvin cycle. Disorder/ diseases of carbohydrate metabolism.

Module-II: Metabolism of lipids and vitamins [10L]

Oxidation of Fatty acid and its regulation: Beta oxidation, Alpha oxidation and omega oxidation of fatty acids - saturated and unsaturated fatty acids - even and odd numbered. Catabolism of phospholipids. Biosynthesis of fatty acids, phospholipids, cholesterol, steroids and Ketone bodies and their regulation. Disorder/ diseases of lipid metabolism. Vitamins and hormones: classification, Structure and Function; Micronutrients.

Srabanti Basu

Module-III: Metabolism of Amino acid and nucleic acid [10L]
Oxidation of amino acids: Transamination, oxidative deamination. Urea cycle and its regulation. Overview of amino acid degradation. Biosynthesis of amino acids and its regulation; Protein turnover. Disorder/ diseases of amino acids metabolism.
Nucleic acid metabolism: nucleotide metabolism, Overview of purine and pyrimidine biosynthesis and degradation, De Novo and Salvage Pathways. Disorder of purines and pyrimidines metabolism.

Module-IV: Cell Signaling [10L]
Cell signaling and signal transduction pathways: Ligands and their receptors, cell surface receptor, signaling through G-protein coupled receptors, second messengers, regulation of signaling pathways, general principles of cell communication, cell adhesion and different adhesion molecules, gap junctions, extracellular matrix, integrins.

Textbook: 1. Lehninger's Principles of Biochemistry by Nelson & Cox, W.H. Freeman Pub.

Reference books:

1. Molecular Biology of the Cell by Bruce Alberts, 4th ed, Garland Science Publishers, 2002
2. Lubert Stryer, Bio chemistry, Freeman & Co, NY
3. Voet & Voet, Fundamentals of Biochemistry, John Willey & Sons
4. Harper's Illustrated Biochemistry - R.K.Murray et al. (McGraw Hill)
5. Outline of Biochemistry - Conn & Stump (John Willey & Sons)

Srabanti Basu

Course Name : Microbiology					
Course Code: BIOT2104					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Course Outcomes:

After completing this course, students will be able to:

1. Describe different cell structures with subcellular functional organelles.
2. Describe the working principles of different types of microscopes.
3. Isolate pure culture from different environmental sources.
4. Preserve and maintain pure culture.
5. Understand various microbial identification processes.
6. Apply their knowledge of microbes in different environmental aspects.

Module-I: Introduction to Microbiology [10L]

Development of microbiology: rejection of abiogenesis theory- major contributions by different scientists: diversification of basic microbiology into different application domains.
Bacteria: morphology, cell structure with subcelluar functional organelles,
Archaebacteria and actinomyces: General morphology, growth characteristics.
Yeast: General morphology and subcellular structure, growth and reproduction.
Fungi: General morphology, sexual and asexual reproduction.
Algae: Classes of algae, cyanobacteria.
Virus: General morphology, virulence, types.
Applications of microbes and Algae in Biotechnology.
Biochemical & Molecular Taxonomical identification of microorganisms.

Module-II: Basic principles and methods in microbiology [10L]

Microscopy: Human visibility and microorganisms, history of development of Microscope, description optical complex microscope. Resolving power, numerical aperture and chromatic aberration Microscopy II: Optical microscope with special utility (phase contrast, fluorescence and inverted microscope), Electron microscope TEM & SEM.
Cultivation of microbes – General media for the growth of bacteria, yeast and fungi, Types of growth media (natural, synthetic, complex, enriched, selective- definition with example), pure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture). Anaerobic (thioglycolate, anaerobic chamber, Robertson's media, microaerophilic), liquid shake culture of aerobic bacteria. Control of microbes: Sterilization, tyndallisation, pasteurization; Physical agents: dry heat, moist heat, UV light, ionizing radiation, filtration, HEPA filter; Chemical agents: antibiotics and antiseptics, disinfectants.

Module-III: Microbial Growth and Metabolism [10L]
Growth of bacteria- Definition, growth phases, kinetics of growth, direct and indirect measurement of growth, The mathematical nature and expression of growth. growth principles of nutrition, influence of environmental factors-pH, temperature, oxygen, Heavy metals and Other compounds. Bacterial growth, fermentation and putrification, Aerobic and anaerobic respiration (definition, examples), fermentation (alcoholic, mixed acid, acetic acid, lactic acid), Entner Duodruffs pathway, bacterial photosynthesis (green and purple bacteria), biochemical nitrogen fixation – non-symbiotic, symbiotic (definition and examples), basic concept of nif-genes. Mod genes, nitrogenase complex, legheamoglobin.

Module-IV: Environmental microbiology [10L]
Air microbiology- Microorganisms in the air, sampling techniques, air borne pathogens. Microbiology of fresh water and wastewater (sewage), water borne diseases (name of pathogen, pathogenicity and preventive measures). Outlines of method for determination of microbial safety of drinking water (presumptive, confirmatory and completed tests). Soil microbiology: soil microbes, different kinds of associations, importance of soil microbes in agriculture.

Textbook:

1. R.C Dubey and D. K Maheshwari -A Text Book of Microbiology, 3rd ed, S. Chand and Company.
2. C.B Powar and H.F Daginawala- General Microbiology (Vol I & II) 3rd ed, Himalaya Publishing House.

Reference books:

1. Stanier R. –General Microbiology, 5thed, Macmilan Press ltd.
2. M. Pelczar, E.Chan, N.Kreig, Microbiology, 5thed, MGH
3. Salle.A.J- Fundamental Principles of Bacteriology, Tata Mcgraw Hill.
4. Hans G. Schlegel, General Microbiology, 7thed, Cambridge Low Price Edition.
5. A.H. Rose, Chemical Microbiology, 3rded, Butterworth World Student Reprints

Course Name : Biomolecular Chemistry Lab					
Course Code: BIOT2151					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

C o u r

se Outcomes:

After completion of this course, the students will be able to:

1. Determine the presence of different biomolecules in a solution.
2. Develop a concept of different types of buffer and pH.
3. Develop the basic principles of spectrophotometric anaylsis.
4. Quantify the concentration of an unknown solution by spectrophotometry.
5. Estimate DNA, RNA and reducing sugars.
6. Determine saponification number and iodine number of lipids.

List of experiments:

1. Qualitative tests for different biomolecules.
2. Buffer & pH: Calibration of pH meter, Preparation of buffer (Tris-HCl or Acetate or Phosphate buffer system) and pH titration of amino acids and validation of the Henderson-Hasselbach equation.
3. Spectroscopy: Verification of Lambert-Beer's law and determination of molar extinction coefficient.
4. Estimation of Reducing Sugars (DNSA method)
5. Estimation of DNA /RNA by chemical method (DNA by diphenyl amine and RNA by orcinol)
6. Determination of Saponification number of lipid
7. Determination of Iodine Number of lipid

Reference Books:

1. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), CUP, Cambridge University Press.
2. Introductory practical Biochemistry by S.K. Sawhney and Randhir Singh (2000), Narosa Publishing House.
3. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw-Hill, Book Company.

Srabanti Basu

Course Name : Biochemistry Lab					
Course Code: BIOT2153					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**1**

Course Outcomes:

After completion of this course, the students will be able to:

1. Estimate sugars by enzymatic method.
2. Develop the concept of enzyme kinetics
3. Determine the activity and specific activity of enzymes.
4. Determine the nature of enzyme inhibition.
5. Estimate the unknown concentration of a protein, cholesterol, vitamin C and liver enzymes.
6. Separate lipids and proteins by chromatographic techniques.

List of experiments:

1. Estimation of sugars by enzymatic method (GOD –POD method)
2. Determination of activity & specific activity of enzyme: K_m and V_{max}
3. Determination of optimum temperature & pH optima of an enzyme
4. Inhibition of Alkaline phosphatase by (F^- or arsenate) and determining the nature of inhibition.
5. Determination of SGPT, SGOT by colorimetric end point method in blood.
6. Estimation of proteins
7. Estimation of cholesterol
8. Estimation of Vitamin C in fruit juice using 2, 6-dichlorophenol indophenols
9. Separation of lipids/ amino acids/ carbohydrates by Thin layer Chromatography (TLC)/ Paper Chromatography.

Reference Books:

1. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), CUP, Cambridge University Press.
2. Introductory practical Biochemistry by S.K. Sawhney and Randhir Singh (2000), Narosa Publishing House.
3. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw-Hill Book Company.

Srabanti Basu

Course Name : Microbiology Lab					
Course Code: BIOT 2154					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	5	5	3

Course Outcomes:

After completion of this course, the students will be able to:

1. Prepare different microbial media and plating.
2. Isolate pure culture by streak, spread and pour plate method.
3. Handle different types of microscopes
4. Determine bacterial growth kinetics
5. Perform the assay of antibiotic by zone inhibition method.
6. Study the biochemical activity of micro organism by some standard tests: IMViC test, hydrolysis of starch, casein etc.

List of experiments:

1. General laboratory procedure; microbial safety and precaution; study of methods of sterilization
2. Preparation of microbial media and plating.
3. Isolation of pure culture by streak, spread and pour plate method.
4. Microscope and microscopy and identification of bacterial sample by differential staining.
5. Determination of microbial load in air, soil and water.
6. Determination of bacterial growth kinetics.
7. Assay of antibiotic by zone inhibition method.
8. Study of biochemical activity of micro organism by some standard tests: IMViC test, hydrolysis of starch, casein etc.
9. Isolation and morphological characterization of fungi.
10. Endospore staining.

Sravanti Basu

<table>
<tr><td colspan="6">Course Name : Thermodynamics and Kinetics</td></tr>
<tr><td colspan="6">Course Code: BIOT2201</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td><td>4</td></tr>
</table>

Course Outcomes:
After completion of this course, the students will be able to:

1. Comprehend the thermodynamic properties and functions of different systems and processes.
2. Apply the thermodynamic laws in practical problems.
3. Relate the thermodynamic properties and functions to biological systems.
4. Explain effect of temperature on rate of reaction.
5. Determine the order of a reaction using different suitable analytical methods.
6. Understand the kinetic mechanism of enzyme-substrate reactions with/without the presence of inhibitor and solve related problems.

Module-I: Basic concept of thermodynamics [10L]

Concept of Enthalpy and Entropy; Phase Rule; PVT behavior of pure substances; Equation of states: Van der Waal's Equation, Virial Equation and its Application; Low temperature processes: Refrigeration and Liquefaction; Residual properties; Chemical Potential and Phase Equilibrium; Fugacity and Fugacity Coefficient; Vapour/Liquid Equilibrium, Roult's Law, Modified Raoult's Law, Henry's law.

Module-II: Bioenergetics and Thermodynamics [10L]

Importance of thermodynamic laws and free energy in Biological system; Thermodynamic properties to understand: Enzymes, ATP synthesis and hydrolysis within cell, metabolism and ATP yield; Protein folding and free energy funnel. Transport across membrane: active transport; activation energy; gradient of chemical potential as driving force in biological process.

Module-III: Kinetics [10L]

Rate of chemical reaction; Effect of Temperature on Rate Constant, Arrehnius equation, Collision Theory, Transition State Theory, Order and Molecularity of a Chemical reaction, Elementary Reactions, First, Second and Third order reactions, Non Elementary Reactions, Pseudo-first order reaction, Determination of rate constant and order of reaction, Half life method, Fractional order reactions.

Srabanti Basu

Module-IV: Applications of Kinetics [10L]

Interpretation of batch reactor data for simple and complex reactions. Kinetics of Enzyme catalyzed reactions for free and immobilized enzymes–derivation of Michaelis-Menten equation, Briggs-Haldane relationship, the determination and significance of kinetic constants, Lineweaver-Burk, Hanes–Woolf plot and Eadie-Hofstee plot, Principles of enzyme inhibition: competitive, noncompetitive and uncompetitive.

Textbook:

1. Smith & Vanness, Thermodynamics for Chemical Engineers, McGraw Hill & Co.
2. Levenspiel. O. Chemical Reaction Engineering, Wiley Eastern Ltd.

Reference books:

1. Richardson, J.F., Peacock, D.G. Coulson & Richardson's Chemical Engineering, Volume 3rd ed., First Indian ed. Asian Books Pvt. Ltd. 1998
2. Bailey & Olis, Biochemical Eng. Fundamentals, McGraw Hill & Co., 1990
3. Gordon G. Hammes, Thermodynamics and Kinetics for the Biological Sciences; John Wiley & Sons, Inc., Publication; 2000
4. Michael L. Shuler, Filkert Kargi, Bioprocess engineering: 2nd edition, Prentice Hall India.

Course Name : Transfer Operation-I					
Course Code: BIOT2202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
After completion of this course, the students will be able to:

1. Understand thy physical properties of fluid, flow behavior and their consequence on fluid flow.
2. Apply the basic laws and equations to analyze fluid dynamics and solve numerical problems related to them.
3. Understand the importance of fluid flow measurement by various devices in industries.
4. Analyze and calculate various parameters involved in heat transfer by conduction, convection and thermal radiation.
5. Develop and design various equipment's associated with heat transfer and evaluate heat exchanger performance.
6. Develop the knowledge of principles of communition, mechanical separation aspects, working of equipments used in mechanical operation and calculate various parameters for energy requirement related to size reduction of solid.

Module-I: Basic concepts of Fluid Mechanics [10L]
Fluid – rheological properties – compressible, incompressible fluids. Newtonian and non Newtonian fluids. Basic equations of fluid flow, fluid flow phenomena – through pipes and other devices – pressure drop calculations. Fluid friction- friction in flow through packed beds. Fundamentals of fluidization and inverse fluidization, gravity settling, terminal settling velocity. Basic concept of multiphase flow-flow regime, pressure drop measurement.

Module-II: Flow measurements and machineries [10L]
Flow measuring devices- orifice and venturi meters, pitot tube, weirs, rotameters and other types of meters. Pipe fittings and valves. Pumps – classification, centrifugal and positive displacement type, peristaltic pump. Principle of compressor and blower.

Module-III: Heat transfer [10L]
Classification of heat flow processes- conduction, convection, radiation. Conduction- Steady state and unsteady state heat conduction. Heat flow in fluids by convection (natural and forced). Heat exchanger- double pipe and shell and tube heat exchanger. Basic concept of radiation.

Module-IV: Mechanical Operations [10L]
Principles of comminution, types of comminuting equipment, energy and power requirement. Crushing, grinding, mixing and agitation, power consumption in mixing. Mechanical separation- screening, filtration (constant pressure and constant rate), centrifugation.

Srabanti Basu

Textbook:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition

Reference books:

1. Geankopolis, Transport Processes & Unit operations: 3rd edition, PHI.
2. Coulson & Richardson, Chemical Engineering, Vol-I & II:, Butterworth Heinemann

3.

Course Name : Molecular Biology					
Course Code: BIOT2203					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Course Outcomes:

After completion of this course, the students will be able to:

1. Identify and analyze the different components and mechanism of replication.
2. Describe different types of DNA damage and repair systems and recombination process.
3. Comment on various components and detailed process of transcription.
4. Comment on various components and mechanism of translation.
5. Understood the rational of genetic code.
6. Comprehend on models of gene regulation and apply the knowledge of gene regulation as genetic switch.

Module-I: Replication and DNA repair in Prokaryotes & Eukaryotes [10L]

The biochemical basis of inheritance, DNA as the genetic material, Central Dogma of molecular biology. Organization of Genome. DNA Replication: Mechanism, Models; Initiation, Elongation & Termination; Enzymes and accessory proteins; Inhibitors of DNA replication; extrachromosomal replicons. Replication in DNA and RNA virus. Mechanisms of different types of DNA Repairs, SOS repair. Repair defects and human diseases. Recombination: Mechanism of general, site specific, recombination.

Module-II: Transcription in Prokaryotes & Eukaryotes [10L]

Structure of and function of different types of RNA, promoter, RNA polymerases: structure and assembly; RNA polymerase I, II, III, transcription factors, terminators. Process of transcription: Initiation, Elongation & Termination of transcription. Post Transcriptional Modifications: Processing of hnRNA, tRNA, rRNA, siRNA, miRNA; 5'-Cap formation; 3'-end processing and polyadenylation; Splicing (different types); RNA editing; Nuclear export of mRNA; mRNA stability; Catalytic RNA, RNA transport, localization and function. Inhibitors of transcription; Reverse transcription; Ribozyme.

Module-III: Genetic code & Translation in Prokaryotes & Eukaryotes [10 L]

Concept of genetic code: Universal genetic code; Degeneracy of codons; Termination codons; Isoaccepting tRNA; Wobble hypothesis. Components translationa: structure and function of ORF, tRNA, rRNA, Ribosomes, RBS, aminoacyl synthetases. Process of Translation: Initiation, Elongation, Termination, Proof-reading, Translational inhibitors. Post translational modifications of protein, Protein folding, Protein trafficking, Protein transport and degradation.

Module-IV: Regulation of Gene Expressions in Prokaryotes & Eukaryotes [10 L]

Molecular structure of gene and its nomenclature. Principle of gene regulation: Negative and Positive Regulation, Structure and function of gene regulatory protein. Regulatory elements: Promoter, Operator, Inducer, Repressor, Activators, Silencers, Insulators, Enhancers. Gene regulation in Prokaryote: concept of Operon Model (*lac, gal, trp* and *ara* operon), Attenuation; antitermination in lambda virus. Gene regulation in Eukaryotes: DNA looping model, hormonal control of gene expression (steroid and non steroid), Role of chromatin, Chromatin remodeling, Gene silencing and Epigenetic regulation. Regulations at level of translation, Riboswitch.

Text books:

1. Molecular Biology of the Gene, 6th Edition, - by J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner.
2. Benjamin Lewin, Gene IX, 9th Edition, Jones and Barlett Publishers, 2007.
3. Essentials of molecular Biology, by Malacinski and Freifelder Jones and Bartlelt Publishers.

Reference books:

1. Molecular and Cellular Biology- by Stefen Wolfe, Wordsworth Publishing Co.
2. Genomes, by T. A. Brown, John Wiley and Sons PTE Ltd.
3. Cell and molecular Biology, Concepts and experiments by Gerald Karp, John Wiley & Sons.
4. The Cell - A molecular approach, by G. M. Cooper, ASM Press.
5. Molecular biology of cell 4thed Alberts, Bruce; Watson, J D(2002) Garland Science Publishing,
6. Molecular cell biology 4th ed Lodish, Harvey and. Baltimore,D(2000) W.H. Freeman and Co.
7. Cell and Molecular Biology 8th ed, Robertis, EDP De & Robertis, EMF De(2002) lippincott, Williams & Wilkins international student edition.

<table>
<tr><td colspan="6">Course Name : Industrial Microbiology and Enzyme Technology</td></tr>
<tr><td colspan="6">Course Code: BIOT2204</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
</table>

Course Outcomes:

After completing this course, students will be able to:

1. Describe different methods for immobilization of enzymes.
2. apply enzymes in various industries that can benefit human life
3. Produce different useful secondary metabolites by microbes.
4. Modify the enzymes for better stability.
5. Design different biosensors for applications in biotechnology.
6. Develop the fermentation techniques and downstream processes.

Module-I: Fermentation process and high-yielding microbes [10L]

Definition and scope, Basic idea on fermentation process, submerged, stationary, solid and semi-solid – with their merits and demerits, Microbial Culture systems; Media for Industrial fermentations; Media optimization; Sterilization of Industrial Media, Cellular control regulating production of microbial metabolites – Primary and Secondary metabolite – Induced mutation technique – Analogue resistant mutant – Catabolic derepressed mutants – Genetically engineered strain – Protoplast fusion technique.

Module-II: Fermentation processes [10L]

Microbial production: Production of organic acids and solvents, microbial polysaccharides, amino acids, enzymes, vitamins, growth factors and hormones, antibiotics and vaccines, alcoholic beverages and other microbial food products.

Downstream processing and fermentation economics. Postproduction techniques and future.

Module III: Enzyme Technology [10L]

Enzyme : brief overview, classification and nomenclature , general characteristics ,Units of enzyme activity, physical and chemical factors affecting enzyme activity, outlines of extraction and purification of commercial enzymes from plant, animal and microbial sources, formulation and stabilization of commercial enzymes. Commercial enzymes: Industrial application Food processing Enzymes of Analytical, diagnostic and medicinal applications Stable enzyme : selection of extremophilic producer Stable enzymes by protein engineering Enzyme electrode & Enzyme sensor Use of Enzymes in non aqueous media.

Module IV: Enzyme applications [10L]

Chemical Modification of enzymes for better stability Enzyme immobilization –Physical and chemical methods for enzyme immobilization. Adsorption, matrix entrapment. Covalent binding, cross linking – advantages and disadvantages of different immobilization techniques. Immobilized enzyme kinetics

General overview on the use of enzymes in different industrial processes

Enzyme electrode and application as biosensor in biotechnology and environmental monitoring. Different bioreactors for processes using immobilized enzymes.

Text books:

1. L.E. Cassida.Jr, Industrial Microbiology, New Age International Publisher.
2. W. Crueger, Annelise Crueger, Biotechnology: A Textbook of Industrial Microbiology, Sinauer Assoc. Inc.
3. Fundamentals of Enzymology by Nicolas C. price and Lewis Stevens. Oxford University Press.
4. Enzymes by Trevor palmer, East west Press 3. Enzyme Technology by Messing

Reference books:

1. Prescott's and Dunn's, A. Industrial Microbiology, 4th edition. CBS Publishers, New Delhi, India, 1987.
2. Atkinson.B and Marituna.F, Biochemical Engineering and Biotechnology Handbok, The Nature Press, Macmillan Publ. Ltd.
3. Enzymes : Dixon and Webb.(IRL Press) Enzyme technology by Chaplin and Bucke. Cambridge University Press.
4. Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, McGraw Hill Intl. Edition.

<table>
<tr><td colspan="6">Course Name : Transfer Operations-I Lab</td></tr>
<tr><td colspan="6">Course Code: BIOT2252</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>3</td><td>2</td></tr>
</table>

Course Outcomes:

After completion of this course, the students will be able to:

1. Design and conduct experiments on flow measurement by venturimeter.
2. Compare the energy loss that occurring in flow measuring devices like venturimeter and orificemeter.
3. Calibrate flow measuring device like rotameter.
4. Conduct experiment, analyze and interpret the data of packed bed reactor operation.
5. Evaluate the performance and calculate the heat transfer coefficient of a double pipe heat exchanger.
6. Understand the operation of comminution equipments like ball mill, jaw crusher and find the energy consumption in operation of those equipments.

List of experiments:

1. Experiments on Reynold's Apparatus-Determination of flow regime and plot of friction factor against NRe.
2. Experiments on flow measuring device—in closed conduit using Venturi meter.
3. Experiments on flow measuring device—in closed conduit using Orifice meter.
4. Experiments on flow measuring device—in closed conduit using Rotameter.
5. Determination of Pressure drop for flow through packed bed & verification of Ergun Equation, Kozeny-Karman equation, Blake-Plummer Equation.
6. Determination of pressure drop in flow through fluidized bed.
7. To study the working characteristics of a Jaw Crusher, calculate the energy consumption as a function of size reduction and compare it with the actual energy requirements.
8. To study the working characteristics of a Ball Mill, calculate the energy consumption as a function of size reduction and determine the critical speed.
9. To Determine the Overall heat transfer coefficient of a double pipe heat exchanger.
10. Determination of thermal conductivity of metal rod or powder.

Srabanti Basu

Course Name : Molecular Biology Lab					
Course Code: BIOT 2253					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:
After completion of this course, the students will be able to:

1. Separate and visualize mixtures of DNA or mixtures of RNA or mixtures of protein.
2. Explain the mechanism of visualization of DNA, RNA and protein.
3. Determine the molecular size of unknown protein and DNA.
4. Estimate the amount of DNA, RNA and protein from a unknown solution by spectrophotometer.
5. Understood the basics of electrophoresis.
6. Able to design experiment to study gene regulation

List of experiments:

1. Agarose Gel Elctrophoresis (AGE).
2. Isolation of Genomic DNA from blood or plant cell or bacterial cell and analysis by AGE.
3. Isolation of Plasmids DNA and analysis by AGE.
4. Determination of molecular size of DNA.
5. Estimation of DNA, RNA and Protein by spectroscopic method.
6. Isolation of RNA and separation by Formaldehyde Agarose gel electrophoresis.
7. Isolation of proteins from bacterial cells and separation by SDS-PAGE.
8. Induced mutation by: (a) Chemical (b) Ultraviolet light.
9. Phage Titration.

Reference Book:

Molecular Cloning – A laboratory manual: 3rd Edition Vol. 1-3. Sambrook J and Russell D.W. (2001). CSHL Press, New York

Course Name : Enzyme Technology & Fermentation Technology Lab					
Course Code: BIOT2254					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes :

After completion of the course, students will be able to:

1. Draw different types of Bioreactors and different components of Bioreactors.
2. Study acid hydrolysis of sucrose in CSTR at different temperature.
3. Carry out immobilization of enzyme by entrapment method.
4. Study Batch Fermentation and assay of Antibiotics (like Penicillin /Streptomycin).
5. Design the steps of production and recovery of Alcohol.
6. Produce different metabolites by Solid State Fermentation technique/process.

List of experiments :

1. Basic Drawing of different types of Bioreactors [Air Lift Reactor (ALR), Bubble column, Continuous Stirred Tanked Reactor (CSTR)] and different components of Bioreactors.
2. Familiarization of different types of analytical instruments including Air Compressor and Autoclave (to know the operation with real sample).
3. Acid hydrolysis of sucrose in CSTR at different temperature.
4. Enzymatic hydrolysis of starch in ALR.
5. Immobilization of enzyme by entrapment method.
6. Operation of immobilized enzyme reactor using a Packed Bed Reactor.
7. Batch Fermentation and Assay of Antibiotics (like Penicillin / Streptomycin).
8. Production of Alcohol (Fermentation and Recovery)
9. Batch Fermentation of Organic Acid
10. Solid State Fermentation

Srabanti Basu

Course Name: BIOLOGY					
Course Code: BIOT2105					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	2	**0**	**0**	**2**	**2**

<u>Course Outcomes:</u>

After completion of the course, the students will be able to:

1. Understand the basic structure and function of cells and cellular organelles.
2. Understand the fundamental concepts of DNA, RNA and central dogma of cells.
3. Characterize the different types of proteins, lipids and carbohydrates.
4. Analyze the mechanism of inheritance of characters through generations.
5. Understand and implement the working principles of enzymes and their applications in biological systems and industry.
6. Design and evaluate different environmental engineering projects with respect to background knowledge about bioresources, biosafety and bioremediation.

MODULE-I: BASIC CELL BIOLOGY

Prokaryotic and Eukaryotic cells, Cell theory; Cell structure and function, Cell organelles, Structure and function of DNA and RNA, Central Dogma; Genetic code and protein synthesis.

MODULE-II: BIOCHEMISTRY AND CELLULAR ASPECTS OF LIFE

Biochemistry of carbohydrates, proteins and lipids; Fermentation; Cell cycle; Basics of Mendelian Genetics.

MODULE-III: ENZYMES AND INDUSTRIAL APPLICATIONS

Enzymes – significance, co-factors and co-enzymes, classification of enzymes; models for enzyme action; Restriction enzymes; industrial applications of enzymes.

MODULE-IV: BIODIVERSITY AND BIOENGINEERING INNOVATIONS

Basic concepts of environmental biosafety, bioresources, biodiversity, bioprospecting, bioremediation, biosensors; recent advances in engineering designs inspired by examples in biology.

TEXT BOOKS:

•Wiley Editorial, “Biology for Engineers: As per Latest AICTE Curriculum,” Wiley-India, 2018.

•S. ThyagaRajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, “Biology for Engineers,” Tata McGraw-Hill, New Delhi, 2012.

REFERENCES

•Jeremy M. Berg, John L. Tymoczko and LubertStryer, “Biochemistry,” W.H. Freeman and Co. Ltd., 6th Ed., 2006.

•Robert Weaver, “Molecular Biology,” MCGraw-Hill, 5th Edition, 2012.

•Jon Cooper, “Biosensors A Practical Approach” Bellwether Books**,** 2004.

•Martin Alexander, “Biodegradation and Bioremediation,” Academic Press, 1994.

•Kenneth Murphy, “Janeway's Immunobiology,” Garland Science; 8th edition, 2011

09/08/2022

Physics-II

(Hons paper for Electrical Engineering)

CODE:PHYS2211 **Contact:4L**

Credit: 4

Course Outcome:

1. To understand the concept of mechanics of Quantum Particles and hence their strange behavior imparting the knowledge of nano – science and its applications in nano technology.
2. To understand how thermodynamics gives rise to completely general relationships among various material properties regardless of microscopic structure.
3. To understand the physics behind the superconducting properties of materials and their industrial and medical usefulness
4. To understand the physics behind X-ray diffraction in crystalline structure of a material, and the different imperfection in it.
5. To understand the basic difference between the atomic structure of an isolated atom and atoms in solids differ and accordingly assures the electrical and thermal properties of solids.
   To study the energy band formation in solids and the behavior of electron and hole in the bands.

Module 1:

Thermodynamics :

Zeroth law and First Law of Thermodynamics: Concept of temperature; heat. Energy, enthalpy, specific heats, first law applied to systems and control volumes, steady and unsteady flow analysis. **(1L)**

Second Law of Thermodynamics:

Kelvin-Planck and Clausius statements, reversible and irreversible processes, Carnot theorems, thermodynamic temperature scale, Clausius inequality and concept of entropy, principle of increase of entropy; availability and irreversibility. Application in chemical reaction. **(2L)**

Properties of Pure Substances:

Thermodynamic properties of pure substances in solid, liquid and vapor phases, P-V-T behaviour of simple compressible substances, phase rule, thermodynamic property tables and charts, ideal and real gases, equations of state, compressibility chart. **(3L)**

Thermodynamic Relations:

T-ds relations, Gibbs and Helmholtz free energies; Concept of phase transition, Chemical potential; different forms of criteria of spontaneity and equilibrium; Maxwell relations; Joule Maxwell equations, Joule-Thomson coefficient, coefficient of volume expansion, adiabatic and isothermal compressibilities, Clapeyron equation, vapor pressure vs temperature relations. **(6L)**

Module 2:

Quantum Mechanics:

Group velocity and Phase Velocity, Heisenberg's Uncertainty Relation and its application, Wave function and its physical interpretation, Postulates of Quantum Mechanics, Schrodinger time dependent and time independent equation , Operator formalism, commutation ,expectation value. **(6L)**

Application of Quantum Mechanics:

Concept of free state and bound state, finite and infinite potential , step potential, Rectangular barrier potential, Square well, One dimensional potential well of finite and infinite depth. Quantum confinement (**6L)**

HOD, EE

Module 3:

Crystal Physics:

Review of Symmetries in solid, Two dimensional and three dimensional Bravias lattices, Millers indices; X-ray Diffraction: Brags law, Laue's equation. Reciprocal lattice, Concept of Brillion Zone, Ewald construction, Structure factor, Imperfections due to point defects, Energy of formation of vacancy, number of vacancies at any temperature, equilibrium concentration of of Schottky and Frenkel defects in ionic crystal , Colour center, Exciton. **(12L)**

Module 4:

Physics of Solids:

Bonding energy of ionic crystal, Vibrations of monoatomic linear lattice, One dimensional diatomic lattice, Concept of phonons, Inelastic scattering of photons and phonons, Einstein and Debye theory of specific heat. **(6L)**

Band Theory of Solids:

Fermi Dirac distribution and its application in metal and semiconductor. Bloch theorem. Kronig-Penny model (qualitative treatment). Origin of energy band formation in solids. Classification of materials into conductors, Semi conductors & Insulators. Concept of effective mass of an electron and hole. (**6 L)**

HOD, EE

Recommended Books:

1. **Atomic Physics Vol 1, S.N.Ghoshal**
2. **Solid State physics by Ashcroft and Mermin.**
3. **Introduction to Solid State Physics by Charles Kittel.**
4. **Heat and Thermodynamics by M.W. Zemansky**
5. **Solid State Physics by A J Dekker**

Course Name: PHYSICS-II					
Course Code: PHYS 2101					
Contact Hours per week:	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Outcomes:

1. Understanding angular momentum kinetic energy and motion of a rigid body with applications in mechanical systems.
2. Understanding calculus of variation as a core principle underlying majority of the physical laws: Newton's laws, Laplace equation (electrostatics and fluid mechanics), wave equation, heat conduction equation,control theory and many other.
3. Appreciating dynamical equations as a consequence of variationalextremization of action functional along with the use of Euler-Lagrange equation to understand the behaviour of simple mechanical systems.\
4. Appreciating the ubiquity of oscillation physics-from pendulum and spring-mass system to electrical circuit and movement of piston and comprehending the small motion of a system around stable equilibrium throughthe notion of normal modes—the meaning of eigenvalue problem in oscillation physics.
5. Fluid Mechanics – An elucidation of the basic principles of fluid mechanics through the study of mass conservation, momentum balance, and energy conservation applied to fluids in motion.
6. Elasticity – A basic understanding of the mechanics of deformable bodies through a study of the concepts of normal and shear stresses and strains, following a review of the principles of statics.

Module I.RIGID BODY DYNAMICS

Angular Momentum, Kinetic Energy, Moment and Product of Inertia, Principal Moments of Inertia, Parallel and Perpendicular Axis Theorems, Examples, Euler Equations of Motion and the Symmetric Top.

12 Lectures

Module II.LAGRANGIAN AND HAMILTONIAN MECHANICS

Principle of Least Action, Virtual Work, Euler-Lagrange Equations, Cyclic Coordinates, Configuration Space, Examples: Simple and Double Pendulum and Atwood Machine. Conservation Laws. Hamilton Equations of Motion

12 Lectures

Module III. SMALL OSCILLATIONS

Small Oscillations of Conservative Systems. Lagrangian and Lagrange Equations of Motion. The Eigenvalue Equation and the Principal Axis Transformation, Coupled Pendulum, Frequencies of Free Vibration and Normal Coordinates

14 Lectures

Module IV. FLUID MECHANICS AND ELASTICITY

Differential Equation of Motion of Fluid Flow, Continuity Equation, Momentum Equation, Euler, Bernoulli and Navier Stokes Equations, Problems and Examples. Integral Form of Continuity and Momentum Equations.
Hooke"s law of Elasticity, Uniform Strain, Young, Bulk and Shear Modulus, The Strain and Stress Tensors. 14 Lectures

References:

1. Classical Mechanics by N. Rana and P. Joag Tata McGraw Hill
2. Classical Mechanics by John Taylor, University Science Books
3. The Variational Principles of Mechanics by Cornelius Lanzos, Dover Publications
4. Schaums Outline of Theoretical Mechanics by M. Spiegel, McGraw Hill
5. Theory of Elasticity by S. P. Timoshenko and J. N. Goodier 3rd Ed. McGraw Hill
6. A Physical Introduction to Fluid Mechanics by A. Smits, John Wiley & Sons

09/08/2022

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering
Detailed Syllabus of 2nd Year 2nd Semester Courses

Course Name: Data Structure and Basic Algorithms					
Course Code: CSEN 2004					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module-1: Linear Data structures I [8L]
Introduction [2L]
i. Concepts of Data and data structure, Data Type and Abstract Data Type.
ii. Algorithms and programs, Different types of algorithms with example
iii. Algorithm efficiency and analysis, time and space analysis of algorithms–order notations.
Array [3L]
i. Different representations – row major, column major
ii. Sparse matrix - its implementation and usage
Linked List [3L]
i. Singly linked list, its operations – with and without tail pointer
ii. Circular linked list, its operations, Doubly linked list,

Module-2: Linear Data structures II [8L]
Stack [3L]
i. Concept, Operations
ii. Implementation (using array, using linked list)
iii. Applications – Evaluation of expressions
Queue [3L]
i. Concept, Operations
ii. Implementation (using array, using linked list)
iii. Circular queue, implementation (using array)
iv. Applications
Recursion [2L]
i. Principles of recursion
ii. Use of stack
iii. Differences between recursion and iteration
iv. Tail recursion

Module-3: Non-linear Data structures [8L]
Trees [5L]
i. Basic terminologies, tree representation (using array, using linked list)
ii. Binary trees-traversal (pre, in, post - order), reconstruction

iii. Binary search tree-operations (creation, insertion, deletion, searching)
iv. Height balanced binary tree –AVL tree (insertion, deletion with examples only)

Graphs [3L]:
i. Basic Terminologies and definitions
ii. Representations/storage implementations–adjacency matrix, adjacency list,
iii. Graph traversal and connectivity–Depth first search (DFS), Breadth first search (BFS)

Module-4: Searching, Sorting, Hashing [8L]

Sorting Algorithms [4L]
i. Bubble sort, Insertion sort, Selection sort
ii. Merge sort, Quicksort,
iii. Comparisons

Searching [2L]
Sequential search, binary search

Hashing [2L]:
Hashing functions, collision resolution techniques

Text Books:

1. "Data Structures And Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
2. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson
3. "Data Structures in C" by Aaron M. Tenenbaum.
4. "Data Structures" by S. Lipschutz.
5. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein.

Course Outcomes:

After the completion of the course the student will be able to:

1. Understand the data structures, their advantages and drawbacks
2. Identify the efficiency aspects of the graph and sorting algorithms covered in this course.
3. Learn about the data structures/ methods/ algorithms mentioned in the course with a comparative perspective
4. Describe problem statements and to design the solutions using programming language
5. Analyze and apply most appropriate data structure/ method/algorithm in a program to enhance the efficiency
6. Develop an efficient program modifying an efficient one using the knowledge gathered from this course.

Heritage Institute of Technology

Department of Applied Electronics & Instrumentation Engineering

Course Name: Data Structure and Basic Algorithms Lab					
Course Code: CSEN 2054					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**1.5**

List of Experiments:

1. Implementation of array operations.
2. Stacks and Queues: adding, deleting elements
3. Circular Queue: Adding & deleting elements
4. Evaluation of expressions operations using stacks.
5. Implementation of linked lists: inserting, deleting, inverting a linked list.
6. Implementation of stacks & queues using linked lists:
7. Sparse Matrices: Multiplication, addition
8. Recursive and Non-recursive traversal of Trees.
9. Binary tree traversal.
10. DFS and BFS.
11. Application of sorting and searching algorithms.

Course Outcome:

After the completion of the course the student will be able to:

1. Write well-structured programs
2. Analyze run-time execution of sorting methods, including selection, merge sort and Quick sort.
3. Implement any ADT using both array based and linked-list based data structures.
4. Design advance data structure using Non-Linear data structure.
5. Select appropriate data structures as applied to specified problem definition.
6. Determine and analyze the complexity of given Algorithms.

EE, CE (In Even Semester)

Paper Name: **MATHEMATICAL METHODS (B. Tech. AEIE,ECE,ME)** (In Odd Semester)					
Paper Code: **MATH 2001**					
Contact hours per week:	L	T	P	Total	Credit Points
	3	1	0	4	4

After successfully completing this course the students will be able to:

MATH2001.1 Construct appropriate mathematical models of physical systems.

MATH2001.2 Recognize the concepts of complex integration, Poles and Residuals in the stability analysis of engineering problems.

MATH2001.3 Generate the complex exponential Fourier series of a function and make out how the complex Fourier coefficients are related to the Fourier cosine and sine coefficients.

MATH2001.4 Interpret the nature of a physical phenomena when the domain is shifted by Fourier Transform e.g. continuous time signals and systems.

MATH2001.5 Develop computational understanding of second order differential equations with analytic coefficients along with Bessel and Legendre differential equations with their corresponding recurrence relations.

MATH2001.6 Master how partial differentials equations can serve as models for physical processes such as vibrations, heat transfer etc.

Detailed Syllabus:

Module I: [12L]

Functions of Complex Variables: Complex numbers and its geometrical representation. Functions of a complex variable – Limits, Continuity, and Differentiability. Analytic Functions, Cauchy- Riemann equations, Necessary and sufficient conditions for analyticity of complex functions (Statement only), Harmonic functions. Line Integral on complex plane, Cauchy-Goursat theorem, Cauchy's Integral Formula. Taylor's and Laurent's series expansion. Zeros, Different types of Singularities. Definitions of poles and residues, Residue Theorem, Evaluation of real integrals using residue theorem.

Module II: [12L]

Fourier Series, Integrals and Transforms: Definite Integral, Orthogonality of Trigonometric Functions, Power Series and its convergence. Periodic Functions, Even and Odd Functions, Dirichlet's Conditions, Euler Formulas for Fourier coefficients, Fourier series representation of a function, e.g. Periodic square wave, Half wave rectifier, Unit step function. Half Range series, Parseval's Identity. Fourier Integral theorem, Fourier transform, Fourier sine and cosine transform, Linearity, Scaling, Frequency Shifting and Time shifting properties, Convolution Theorem. Discussion of some physical problems: e.g Forced oscillations.

<u>Module III:</u> [12L]

Series Solutions to Ordinary Differential Equations and Special Functions: Series solution of ODE: Ordinary point, Singular point and Regular Singular point, series solution when $x = a$ is an ordinary point, Frobenius method. Legendre's Equation, Legendre's polynomial and its graphical representation. Bessel's equation, Bessel's function of first kind and its graphical representation. Finite Difference Method and its application to Boundary Value Problem.

<u>Module IV:</u> [12L]

Partial Differential Equations: Introduction to partial differential equations, Formation of partial differential equations, Linear and Nonlinear PDEs of first order, Lagrange's and Charpit's method of solution. Second order partial differential equations with constant coefficients, Illustration of wave equation, one dimensional heat equation, Laplace's equation, Boundary value problems and their solution by the method of separation of variables. Solution of Boundary value problems by Laplace and Fourier transforms.

<u>References:</u>

1. Complex Variables and Applications, Brown Churchill, Mc Graw Hill
2. Complex Variable, Murrey R. Spiegel, Schaum's Outline Series
3. Theory of Functions of a Complex Variable, Shanti Narayan, P. K. Mittal, S. Chand
4. Larry C. Andrew, B. K. Shivamoggi, Integral Transforms for Engineers and Applied Mathematicians, Macmillan
5. Fourier Analysis with Boundary Value Problem, Murrey R. Spiegel, Schaum's Outline Series
6. Mathematical Methods, Potter, Merle C., Goldberg, Jack. PHI Learning
7. Ordinary and Partial Differential Equations, M. D. Raisinghania, S. Chand
8. Elements of Partial Differential Equation, Ian Naismith Sneddon, Dover Publications
9. Advanced Engineering Mathematics, Kreyszig, Willey
10. Higher Engineering Mathematics, B. V. Ramana, Tata McGraw-Hill

The topics of the syllabus relate to skill development depending on the programme for example,
(i) in case of B.Tech. in Mechanical Engineering, Module IV is having direct relationship with skill development like Modeling of mechanical, thermal, hydraulic and other phenomena.
(ii) in case of B.Tech. in Applied Electronics and Instrumentation Engineering, Electronics and Communication Engineering and Electrical Engineering, Module II is used for developing the skill for signal processing, image processing etc.

Sandip Chatterjee

Paper Name: **ADVANCED NUMERICAL METHODS (B. Tech. ECE)**					
Paper Code: **MATH2202**					
Contact hours per week:	L	T	P	Total	Credit Points
	4	0	0	4	4

After successfully completing this course the students will be able to:

MATH2202.1 Analyze certain algorithms, numerical techniques and iterative methods that are used for solving system of linear equations.
MATH2202.2 Implement appropriate numerical methods for solving advanced engineering problems dealing with interpolation, integration and differentiation.
MATH2202.3 Apply the knowledge of matrices for calculating eigenvalues and eigenvectors and their stability for reducing problems involving Science and Engineering
MATH2202.4 Develop an understanding to reduce a matrix to its constituent parts in order to make certain subsequent calculations simpler.
MATH2202.5 Apply various optimization methods for solving realistic engineering problems.
MATH2202.6 Compare the accuracy and efficiency of the above mentioned methods.

Detailed Syllabus:

Module I: [10L]

System of Linear Equations: Gauss Elimination Method, pivoting and scaling. Gauss-Jordan, Gauss-Jacobi and Gauss-Seidel Methods and their computational complexity. Symmetric positive definite systems and indefinite systems: Cholesky factorization. Error Analysis: error prediction and acceleration.

Module II: [9L]

Eigen Value problems: Eigenvalue location, error and stability of eigenvalues, QR algorithm, Power method, inversion iteration in finding dominant eigenvalues and eigenvectors of sparse matrices. Singular value decomposition, application of SVD.

Module III: [12L]

Interpolation, Integration & Differentiation: Purpose of interpolation, choice of interpolating function: Newton's forward and backward interpolation. Polynomial interpolation: Lagrange's method. Newton's divided difference interpolation. Computational complexity of these methods. Piecewise polynomial interpolation: cubic spline interpolation. General form of quadrature rule: Newton-Cotes quadrature. Trapezoidal rule, Simpson's 1/3rd rule, Weddle's rule. Gaussian quadrature rule.

Module IV: [9L]

Optimization: Unimodal functions. One-dimensional unconstrained optimization algorithms: interval halving, Dichotomous search, Golden section search, Fibonacci search. Cubic spline interpolation. Nonlinear Least Squares.

Sandip Chatterjee

.

References:

Text Books:

1. Trefethen L. N. and Bau D. *Numerical Linear Algebra*, SIAM
2. Watkins D. S. *Fundamentals of Matrix Computation*, Wiley
3. Smith G. D. *Numerical Solutions to Partial Differential Equations*, Oxford University Press
4. Jain M. K. and Iyengar S.R.K. *Numerical methods for scientific and engineering computation*
5. Conte S. D. and Boor C. D. *Elementary Numerical Analysis - An Algorithmic Approach*, McGraw Hill
6. Atkinson K. E. *Introduction to Numerical Analysis*,John Wiley
7. S. S. Rao, *Engineering Optimization*, New Age International Publishers

Reference Books:

1. Golub G. H. and Van Loan C.F. *Matrix Computation*, John Hopkins U. Press, Baltimore
2. Stewart G. W. *Introduction to Matrix Computations*, Academic Press
3. Demmel J.W. *Applied numerical linear algebra*, SIAM, Philadelphia
4. Jain M.K. *Numerical Solutions of Differential Equations*
5. Smith, *Numerical solutions of partial Differential Equations (Finite difference methods)*
6. Heath M. T., *Scientific Computing: An Introductory Survey*, McGraw Hill
7. Joe D. Hoffman, *Numerical Methods for Engineers and Scientists*, McGraw Hill

Sandip Chatterjee

Paper Name: **ADVANCED NUMERICAL METHODS LAB**					
Paper Code: **MATH 2252**					
Contact hours per week:	L	T	P	Total	Credit Points
	0	0	2	2	1

<u>After successfully completing this course the students will be able to:</u>

MATH2252.1 Write programs in C to solve problems based on numerical methods.
MATH2252.2 Apply their knowledge of C programming to find non-iterative exact solutions of a system of equations.
MATH2252.3 Use C programming to develop algorithms to find iterative approximate solutions of a system of equations.
MATH2252.4 Demonstrate their ability of C programming to solve problems involving interpolation.
MATH2252.5 Use MATLAB to implement algorithms in optimization problems.
MATH2252.6 Study the role of recurrence relations in optimization algorithms using MATLAB.

<u>Detailed Syllabus:</u>

Development of computer programs in C and/or MATLAB for the following problems:

1. Gauss-elimination Method with complete and total pivoting.
2. Gauss-Seidel Method with diagonal dominance.
3. Newton's Forward Interpolation (polynomial to be printed).
4. Lagrange's interpolation (polynomial to be printed).
5. Implementation of one-dimensional unconstrained optimization algorithms (for example: Dichotomous search, Golden section search, Fibonacci search etc by MATLAB).

Sandip Chatterjee

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Detailed syllabus of 5th semester:

Course Name : Formal Language & Automata Theory					
Course Code: CSEN3101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Module-1: [9L]
Fundamentals: Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram, Design of sequence detector (Application of concept of Automata to sequential circuit design), Introduction to finite state model [2L]
Finite state machine: Definitions, capability & state equivalence, kth- equivalence concept[1L]
Deterministic finite automaton and non deterministic finite automaton. Transition diagrams and Language recognizers. [1L]
Finite Automata: NFA with ε transitions - Significance, acceptance of languages. [1L]
Conversions and Equivalence: Equivalence between NFA with and without ε transitions. NFA to DFA conversion. [1L]
Minimization of FSM, Equivalence between two FSM's , Limitations of FSM [1L]
Application of finite automata, Finite Automata with output- Moore & Mealy machine. [2L]

Module-2: [10L]
Introduction to Formal Languages and Grammars [1L]
Chomsky Classification of grammar: unrestricted, context sensitive, context free grammar [1L]
Grammar Formalism: Right linear and left linear grammars, Regular grammar, Regular Languages, Regular sets [1L]
Regular expressions, identity rules. [1L]
Arden's theorem statement, proof and applications [1L]
Constructing finite Automata for a given regular expressions, Regular string accepted by NFA/DFA [1L]
Pumping lemma of regular sets.[1L]
Closure properties of regular sets (proofs not required). [2L]
Equivalence between regular grammar and FA. [1L]

Module-3: [10L]
Context free grammar: Introduction to Context free grammars, Derivation trees, Sentential forms, Right most and leftmost derivation of strings, basic applications of the concept of CFG [1L]
Ambiguity in context free grammars. [1L]
Minimization of Context Free Grammars : Removal of useless, null and unit productions [1L]
Chomsky normal form and Greibach normal form. [1L]
Pumping Lemma for Context Free Languages. [1L]
Enumeration of properties of CFL (proofs omitted). Closure property of CFL, Ogden's lemma & its applications [1L]
Push Down Automata: Push down automata, Definition and design of PDA [1L]
Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. [1L]
Equivalence of CFL and PDA, interconversion. (Proofs not required). [1L]
Introduction to DCFL and DPDA. [1L]

Module-4: [11L]
Turing Machine : Introduction to Turing Machine, Definition, Model [1L]
Design of TM, TM as language accepter[1L]
TM as transducers [1L]
Computable functions [1L]
Languages accepted by a TM, recursively enumerable and recursive languages [1L]

Church's hypothesis, counter machine [1L]
Types of Turing machines (proofs not required) [1 L]
Universal Turing Machine [1L]
Decidability, Undecidability, Various Undecidable problems like Post's Correspondence Problem (PCP), Turing Machine Halting Problem, Ambiguity of Context Free Grammars etc. [3L]

Course Outcome:

1. Students will be able to design Turing machine as language accepter as well as a transducer.
2. Students will be able to classify a grammar and a language, design a Finite Automata for a regular expression and derive the regular expression for a FA. Students will be able to check equivalence between regular grammar and FA.
3. Students will be able to minimize context free grammar, derive it's normal forms and recognize a CFG. They will be able to design a PDA for a given CFL. Student will be able to check equivalence of CFL and PDA.
4. The student will be able to define a system and recognize the behavior of a system. They will be able to minimize a system and compare different systems.

TEXT BOOKS:

1."Introduction to Automata Theory Language and Computation", Hopcroft H.E. and Ullman J. D., Pearson Education.
2."Theory of Computer Science ", Automata Languages and computation", Mishra and Chandrashekaran, 2nd edition, PHI.
3."Formal Languages and Automata Theory", C.K.Nagpal, Oxford.
4. "Introduction to the Theory of Computation", Sipser Michael. Cengage Learning.

REFERENCES:

1 "Switching & Finite Automata", ZVI Kohavi, 2nd Edn., Tata McGraw Hill
2 "Introduction to Computer Theory", Daniel I.A. Cohen, John Wiley
3 "Introduction to languages and the Theory of Computation", John C Martin, TMH
4 "Elements of Theory of Computation", Lewis H.P. & Papadimitrou C.H. Pearson, PHI.

Course Name : Database Management Systems					
Course Code: CSEN3102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

MODULE-I
Introduction [4L]
Concept & Overview of DBMS, Data Models, Database Languages, Role of database administrator and database Users, Three Tier architecture of DBMS.
Entity-Relationship Model [6L]
Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

MODULE-II
Relational Model [5L]
Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database.
Relational Database Design [9L]
Functional Dependency, Different anamolies in designing a Database., Normalization using funtional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Nomalization using multi-valued depedencies, 4NF, 5NF.

Church's hypothesis, counter machine [1L]
Types of Turing machines (proofs not required) [1 L]
Universal Turing Machine [1L]
Decidability, Undecidability, Various Undecidable problems like Post's Correspondence Problem (PCP), Turing Machine Halting Problem, Ambiguity of Context Free Grammars etc. [3L]

Course Outcome:

1. Students will be able to design Turing machine as language accepter as well as a transducer.
2. Students will be able to classify a grammar and a language, design a Finite Automata for a regular expression and derive the regular expression for a FA. Students will be able to check equivalence between regular grammar and FA.
3. Students will be able to minimize context free grammar, derive it's normal forms and recognize a CFG. They will be able to design a PDA for a given CFL. Student will be able to check equivalence of CFL and PDA.
4. The student will be able to define a system and recognize the behavior of a system. They will be able to minimize a system and compare different systems.

TEXT BOOKS:

1."Introduction to Automata Theory Language and Computation", Hopcroft H.E. and Ullman J. D., Pearson Education.
2."Theory of Computer Science ", Automata Languages and computation", Mishra and Chandrashekaran, 2nd edition, PHI.
3."Formal Languages and Automata Theory", C.K.Nagpal, Oxford.
4. "Introduction to the Theory of Computation", Sipser Michael. Cengage Learning.

REFERENCES:

1 "Switching & Finite Automata", ZVI Kohavi, 2nd Edn., Tata McGraw Hill
2 "Introduction to Computer Theory", Daniel I.A. Cohen, John Wiley
3 "Introduction to languages and the Theory of Computation", John C Martin, TMH
4 "Elements of Theory of Computation", Lewis H.P. & Papadimitrou C.H. Pearson, PHI.

Course Name : Database Management Systems					
Course Code: CSEN3102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

MODULE-I
Introduction [4L]
Concept & Overview of DBMS, Data Models, Database Languages, Role of database administrator and database Users, Three Tier architecture of DBMS.
Entity-Relationship Model [6L]
Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

MODULE-II
Relational Model [5L]
Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database.
Relational Database Design [9L]
Functional Dependency, Different anamolies in designing a Database., Normalization using funtional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Nomalization using multi-valued depedencies, 4NF, 5NF.

COURSE STRUCTURE OF B. TECH IN
COMPUTER SCIENCE & ENGINEERING, HIT

MODULE-III

SQL and Integrity Constraints [8L]

Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

MODULE-IV

Internals of RDBMS [7L]

Physical data structures, Query optimization: join algorithm, statistics and cost based optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols, two phase locking.

File Organization & Index Structures [6L]

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree.

Dr. Subhashis Majumdar

Course outcomes:

1. Differentiate database systems from file systems by enumerating the features provided by database systems and describe each in both function and benefit.
2. Define the terminology, features, classifications, and characteristics embodied in database systems.
3. Analyze an information storage problem and derive an information model expressed in the form of an entity relation diagram and other optional analysis forms, such as a data dictionary.
4. Demonstrate an understanding of the relational data model.
5. Transform an information model into a relational database schema and to use a data definition language and/or utilities to implement the schema using a DBMS.
6. Formulate, using relational algebra, solutions to a broad range of query problems.
7. Formulate, using SQL, solutions to a broad range of query and data update problems.
8. Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
9. Use an SQL interface of a multi-user relational DBMS package to create, secure, populate, maintain, and query a database.
10. Use a desktop database package to create, populate, maintain, and query a database.
11. Demonstrate a rudimentary understanding of programmatic interfaces to a database and be able to use the basic functions of one such interface.

Text Books:

1. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing Company.
3. Ramakrishnan: Database Management System , McGraw-Hill.
4. Gray Jim and Reuter Address, “Transaction Processing: Concepts and Techniques”, Moragan Kauffman Publishers.
5. Jain: Advanced Database Management System CyberTech.
6. Date C. J., “Introduction to Database Management”, Vol. I, II, III, Addison Wesley.
7. Ullman JD., “Principles of Database Systems”, Galgottia Publication.

References:

1. James Martin, “Principles of Database Management Systems”, 1985, Prentice Hall of India, New Delhi
2. “Fundamentals of Database Systems”, Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition.
3. “Database Management Systems”, Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : OPERATING SYSTEMS					
Course Code: CSEN3103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Module I:
Introduction [4L]
Introduction to Operating System. Operating system functions, OS Architecture (Monolithic, Microkernel, Layered, Hybrid) , evaluation of O.S., Different types of O.S.: batch, multi-programmed, time-sharing, real-time, distributed, parallel.
System Structure [3L]
Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services, System calls.

Module II:
Process Management [17L]
Processes [3L]: Concept of processes, process scheduling, operations on processes, co-operating processes, inter-process communication.
Threads [2L]: overview, benefits of threads, user and kernel threads.
CPU scheduling [3L]: scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling.
Process Synchronization [5L]: background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.
Deadlocks [4L]: system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

Module III:
Storage Management [19L]
Memory Management [5L]: background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.
Virtual Memory [3L]: background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing.
File Systems [4L]: file concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance.
I/O Management [4L]: I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and non-blocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.
Disk Management [3L]: disk structure, disk scheduling (FCFS, SSTF, SCAN,C-SCAN) , disk reliability, disk formatting, boot block, bad blocks.
Module IV:
Protection & Security [4L]
Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.

Course Outcomes:
1. Master functions, structures and history of operating systems.
2. Master understanding of design issues associated with operating systems.
3. Master various process management concepts including scheduling, synchronization, deadlocks.
4. Be familiar with multithreading.
5. Master concepts of memory management including virtual memory.
6. Be familiar with issues related to file system interface and implementation, disk management, protection and security.

References :

1. Milenkovie M., “Operating System : Concept & Design”, McGraw Hill.
2. Tanenbaum A.S., “Operating System Design & Implementation”, Practice Hall NJ.
3. Silbersehatz A. and Peterson J. L., “Operating System Concepts”, Wiley.
4. Dhamdhere: Operating System TMH
5. Stalling, William, “Operating Systems”, Maxwell McMillan International Editions, 1992.
6. Dietel H. N., “An Introduction to Operating Systems”, Addison Wesley.

Course Name : Computer Architecture					
Course Code: CSEN3104					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module 1:
Introduction: (2L)
Review of basic computer architecture;
Pipelining: (9L)
Basic concepts, Instruction and arithmetic pipeline, Scheduling in Pipeline; Data hazards, control hazards and structural hazards, techniques for handling hazards.

Module 2:
Instruction-level parallelism: (6L)
Basic concepts, Array and vector processors. Superscalar, Superpipelined and VLIW processor architectures.
Interconnection networks: (4L)
Crossbar, Delta, Omega, Shuffle-Exchange, Banyan , Hypercube, Butterfly Networks.

Module 3:
Measuring and reporting performance: (2L)
CPI,MIPS etc**.** Amdahl’s Law & Gustafson’s Law.
Hierarchical memory technology: (4L)
Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies.
Multiprocessor architecture: (6L)
Taxonomy of parallel architectures; Centralized shared- memory architecture; Distributed shared-memory architecture. Cluster computers.

Module 4:
Issues with Multiprocessor Architectures: (4L)
Synchronization, memory consistency; Cache Coherence protocols (brief discussion only);
Non von Neumann architectures: (3L)
Data flow computers, RISC architectures, Systolic architectures.

References:

1. **Kai Hwang:** Advanced Computer Architecture – Parallelism, etc.
2. **Hennessey & Patterson :** Computer Architecture – A Quantitative Approach
3. **Hamacher et el:** Computer Organization (5^{th} Ed) & above
4. Kai Hwang & Briggs: Computer Architecture & Parallel Processing

Course Outcome:
CO1: Analyze the concept of pipelining, segment registers and pin diagram of CPU.
CO2: Understand and analyze various issues related to memory hierarchy.
CO3: Examine various inter connection structures of multi processor.
CO4. Design architecture with all the required properties to solve state-of-the-art problems

References :

1. Milenkovie M., “Operating System : Concept & Design”, McGraw Hill.
2. Tanenbaum A.S., “Operating System Design & Implementation”, Practice Hall NJ.
3. Silbersehatz A. and Peterson J. L., “Operating System Concepts”, Wiley.
4. Dhamdhere: Operating System TMH
5. Stalling, William, “Operating Systems”, Maxwell McMillan International Editions, 1992.
6. Dietel H. N., “An Introduction to Operating Systems”, Addison Wesley.

Course Name : Computer Architecture					
Course Code: CSEN3104					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module 1:
Introduction: (2L)
Review of basic computer architecture;
Pipelining: (9L)
Basic concepts, Instruction and arithmetic pipeline, Scheduling in Pipeline; Data hazards, control hazards and structural hazards, techniques for handling hazards.

Module 2:
Instruction-level parallelism: (6L)
Basic concepts, Array and vector processors. Superscalar, Superpipelined and VLIW processor architectures.
Interconnection networks: (4L)
Crossbar, Delta, Omega, Shuffle-Exchange, Banyan , Hypercube, Butterfly Networks.

Module 3:
Measuring and reporting performance: (2L)
CPI,MIPS etc**.** Amdahl’s Law & Gustafson’s Law.
Hierarchical memory technology: (4L)
Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies.
Multiprocessor architecture: (6L)
Taxonomy of parallel architectures; Centralized shared- memory architecture; Distributed shared-memory architecture. Cluster computers.

Module 4:
Issues with Multiprocessor Architectures: (4L)
Synchronization, memory consistency; Cache Coherence protocols (brief discussion only);
Non von Neumann architectures: (3L)
Data flow computers, RISC architectures, Systolic architectures.

References:

1. **Kai Hwang:** Advanced Computer Architecture – Parallelism, etc.
2. **Hennessey & Patterson :** Computer Architecture – A Quantitative Approach
3. **Hamacher et el:** Computer Organization (5^{th} Ed) & above
4. Kai Hwang & Briggs: Computer Architecture & Parallel Processing

Course Outcome:
CO1: Analyze the concept of pipelining, segment registers and pin diagram of CPU.
CO2: Understand and analyze various issues related to memory hierarchy.
CO3: Examine various inter connection structures of multi processor.
CO4. Design architecture with all the required properties to solve state-of-the-art problems

<table>
<tr><td colspan="6">Course Name : Data Structure & Algorithm</td></tr>
<tr><td colspan="6">Course Code: CSEN3106</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
</table>

Course Outcomes:
Upon successful completion of this course students should be able to:

1. Identify and select appropriate data structures as applied to specified problem definition.
2. Implement operations like searching, insertion, deletion, traversal etc. on linear data structures like array, stack and queue.
3. Implement operations like searching, insertion, deletion, traversal etc. on nonlinear data structures like tree and graph.
4. Apply appropriate sorting/searching technique for given problem.
5. Analyze and compare the different sorting algorithms.
6. Design advanced data structure using Nonlinear data structures.

Module -I. Linear Data Structure I [8L]
Introduction (2L):
Why we need data structure?
Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.
Algorithms and programs, basic idea of pseudo-code.Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.
Array (2L):
Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.
Linked List (4L):
Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Module -II: Linear Data Structure II [6L]
Stack and Queue (4L):
Stack and its implementations (using array, using linked list), applications.
Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list)
Recursion (2L):
Principles of recursion – use of stack, differences between recursion and iteration, tail recursion.

Module -III. Nonlinear Data structures [13L]

Trees (9L):

Basic terminologies, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only).

Graphs (4L):

Graph representations/storage implementations – adjacency matrix, adjacency list,
Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS)

Module - IV Searching, Sorting, Hashing. [9L]

Sorting Algorithms (5L):

Bubble sort, insertion sort, selection sort, merge sort, quicksort, heap sort, radix sort.

Searching (1L):

Sequential search, binary search

Hashing (3L):

Hashing functions, collision resolution techniques (Open and closed hashing).

Recommended books:

1. “Data Structures And Program Design In C”, 2/E by Robert L. Kruse, Bruce P. Leung.
2. “Fundamentals of Data Structures of C” by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
3. “Data Structures in C” by Aaron M. Tenenbaum.
4. “Data Structures” by S. Lipschutz.
5. “Introduction to Algorithms” by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

Course Name: Electronic Design Automation Lab					
Course Code: ECEN3156					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

1. Course Outcomes

After completion of the course, students will be able to:

ECEN3156.1. Learning Industry Standard Frontend and Synthesis CAD Tool (Xilinx Vivado).
ECEN3256.1. Learning Industry Standard Verilog RTL Behavioral and Structural Design.
ECEN3356.1. Learning Logic Synthesis and Place and Route using FPGA Flow.
ECEN3456.1. Learning Industry Standard Backend CAD Tool (Mentor Graphics).
ECEN3556.1. Designing CMOS Combinational Digital Gates
ECEN3656.1. Designing CMOS/TG Sequential Digital Gates.

2. Detailed Syllabus

List of Experiments:

1. Familiarities with Xilinx Vivado Front end and Synthesis CAD Tool
2. Verilog RTL Design and Testing of Digital Gates (INV, NAND, NOR, MUX, AOI, OAI …)
3. Verilog RTL Design and Testing of Functional Blocks (Adder, Decoder, ALU …)
4. Verilog RTL Design and Testing of Sequential Gates (Latch, Flop …)
5. Verilog RTL Structural Design and Testing of Functional Blocks
6. Verilog RTL Design and Testing for Finite State Machine (Mealy, Moore)
7. Logic Synthesis and P & R using Vivado for FPGA
8. Familiarity with Mentor Graphics Back end CAD Tool
9. CMOS Inverter, NAND, NOR Delay, VTC, Noise Analysis
10. CMOS/TG Sequential Design and Analysis

3. Textbooks

1. Principles of CMOS VLSI Design, A Systems Perspective, Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition.
2. Algorithms for VLSI Physical Design Automation, N. Sherwani, Kluwer Academic Publishers (3rd edition).

4. Reference Books

1. CMOS Digital Integrated Circuits, Analysis and Design, Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition).
2. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition), Neil Weste, David Harris, Ayan Banerjee. Pearson.
3. Digital Integrated Circuit, Design Perspective, M. Rabaey, Prentice-Hall.
4. VLSI Design and EDA TOOLS, Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, Scitech Publications (India) Pvt. Ltd., 2011.
5. Algorithms for VLSI Design Automation, Gerez, Wiley, 2011.

C. HONORS COURSES

Course Name: Artificial Intelligence					
Course Code: CSEN3111					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

1. Course Outcomes

After completion of the course, students will be able to:

CSEN3111.1. Remember and understand the basic principles of state-space representation of any given problem, various searching and learning algorithms, game playing techniques, logic theorem proving etc.
CSEN3111.2. Comprehend the importance of knowledge as far as intelligence is concerned and the fundamentals of knowledge representation and inference techniques.
CSEN3111.3. Apply this knowledge so that it can be used to infer new knowledge in both certain and uncertain environment
CSEN3111.4. Apply various AI searching algorithms, like state-space search algorithm, adversarial search algorithm, constraint satisfaction search algorithm as and when required.
CSEN3111.5. Understand the working knowledge of Prolog/ Lisp in order to write simple Prolog/ Lisp programs and explore more sophisticated Prolog/ Lisp code on their own.
CSEN3111.6. Design and evaluate the performance of a heuristic applied to a real-world situation.

2. Detailed Syllabus

Module 1 [9L]

Introduction: Definition of AI, Intelligent Behavior, Turing Test, Typical AI Problems, Various AI Approaches, Limits of AI.
Introduction to Intelligent Agents: Agents & environment, Agent Architecture, Agent Performance, Rational Agent, Nature of Environment, Simple Reflex Agent, Goal Based Agent, Utility Based Agent.
Knowledge Representation & Propositional Logic: Knowledge representation issues, Approaches to knowledge representation, Propositional Logic – its syntax & semantics, Inference rules, Resolution for propositions, Limitation of Propositional Logic.
Problem Solving using Single Agent Search: Introduction to State-space search, state-space search notation, search problem, Formulation of some classical AI problems as a state space search problem, Explicit Vs. Implicit State space.
Uninformed Search Techniques: Basic Principles, Evaluating parameters, BFS, DFS, Depth Limited Search, Iterative Deepening DFS, Uniform Cost Search & Bidirectional Search, Properties of various search methods & their comparative studies.

Module 2 [9L]

Informed Search Methods: Basic Principles, Heuristics, A* Search and its properties, Admissible & Consistent heuristic, Iterative deepening A* (IDA*) and AO* search, Local Search Techniques – Hill climbing & Simulated Annealing, Comparison with other methods
Problem Solving using Two Agent Search: Adversarial Search – Game Tree, MINIMAX Algorithm, Alpha-Beta Pruning, Performance Analysis.
Constraint Satisfaction Problem: Definition of CSP, Representation of CSP, Formulation of Various popular problems as CSP, Solution methods of CSP – Backtracking & Forward Checking.

Module 3 [9L]

Knowledge Representation & Predicate Logic: Syntax & Semantics of FOPL, Representation of facts using FOPL, Clauses, Resolution, Unification methods of inference, Default & Non-Monotonic reasoning.
Knowledge Representation using Rules: Rule based system, Horn clauses, Procedural vs. declarative knowledge, forward & backward reasoning, Introduction of logic programming using PROLOG/ LISP.
Probabilistic reasoning: Representing knowledge in an uncertain domain, probabilistic inference rules, Bayesian networks – representation & syntax, semantics of Bayesian net, Brief discussion on Fuzzy sets & fuzzy logic.
Other Representational Formalism: Inheritable knowledge, Semantic network, Inference in Semantic network, Extending Semantic Network, Frames, Slots as objects.

Module 4 [9L]

Planning: Introduction, Simple planning agent, Problem solving vs. planning, Logic based planning, Goal Stack planning, Planning as a search, Total-order vs. partial order planning.
Learning: Overview, Taxonomy of learning system, various learning models, learning rules, Naive Bayes classifier and Decision tree based learning, Brief idea about learning using Neural Network & Genetic Algorithm.
Natural Language Processing: Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.
Expert Systems: Representing and using domain knowledge, expert system shells, and knowledge acquisition.

3. Textbooks

1. Artificial Intelligence: A Modern Approach, Stuart Russell & Peter Norvig, Pearson Education. Type text here
2. Artificial Intelligence, Rich & Knight, TMH.

4. Reference Books

1. Artificial Intelligence & Intelligent Systems, N.P Padhy, Oxford University Press.
2. Introduction to Artificial Intelligence & Expert Systems, Dan W. Patterson, PHI.
3. Artificial Intelligence: A new Synthesis, Nils J. Nilsson, Morgan Kaufmann Publishers, Inc.
4. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Database Management Systems Lab					
Course Code: CSEN3112					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

Creating Database
1. Creating a Database
2. Creating a Table
3. Specifying Relational Data Types
4. Specifying Constraints
5. Creating Indexes

Table and Record Handling
1. INSERT statement
2. Using SELECT and INSERT together
3. DELETE, UPDATE, TRUNCATE statements
4. DROP, ALTER statements

Retrieving Data from a Database
1. The SELECT statement
2. Using the WHERE clause
3. Using Logical Operators in the WHERE clause
4. Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause
5. Using Aggregate Functions
6. Combining Tables Using JOINS
7. Subqueries

Database Management
1. Creating Views
2. Creating Column Aliases
3. Creating Database Users
4. Using GRANT and REVOKE
5. Cursors in Oracle PL / SQL
6. Writing Oracle PL / SQL Stored Procedures.

Course outcomes:
1. To provide a sound introduction to the discipline of database management as a subject in its own right, rather than as a compendium of techniques and product-specific tools.
2. To familiarize the participant with the nuances of database environments towards an information-oriented data-processing oriented framework.
3. To give a good formal foundation on the relational model of data.
4. To present SQL and procedural interfaces to SQL comprehensively
5. To give an introduction to systematic database design approaches covering conceptual design, logical design and an overview of physical design.
6. To motivate the participants to relate all these to one or more commercial product environments as they relate to the developer tasks.
7. To present the concepts and techniques relating to query processing by SQL engines.
8. To present the concepts and techniques relating to ODBC and its implementations.
9. To introduce the concepts of transactions and transaction processing.
10. To present the issues and techniques relating to concurrency and recovery in multi-user database environments.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Operating Systems Lab					
Course Code: CSEN3113					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	2

1. Shell programming [6P]: Creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions and commands).
2. Process [6P]: starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
3. Signal [9P]: signal handling, sending signals, signal interface, signal sets.
4. Semaphore [6P]: programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v.
5. POSIX Threads [9P]: programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)
6. Inter-process communication [9P]: pipes(use functions pipe, popen, pclose), named
7. pipes (FIFOs, accessing FIFO).

Dr. Subhashis Majumder

Learning Outcomes/Course Outcomes:
Upon the completion of Operating Systems practical course, the student will be able to:
1. Understand and implement basic services and functionalities of the operating system using system calls.
2. Will be able to describe and write shell scripts in order to perform basic shell programming.
3. Will be able to describe and create user defined processes.
4. Understand the benefits of thread over process and implement them.
5. Synchronization programs using multithreading concepts.
6. Use modern operating system calls and synchronization libraries in software to implement process synchronization.
7. Implementation of Inter-process communication using PIPE.

References:

1. Sumitabha Das. Your Unix The Ultimate Guide, MH.
2. Neil Matthew, Richard Stones, Beginning Linux Programming, Wrox.

Subject Name: Computer Architecture Lab					
Paper Code: CSEN 3114					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	2

VHDL introduction
1. Design digital logic gate (OR, AND, XOR,NOT, NAND, NOR) simulation
2. Implement basic gates using Universal gates.
3. Implement 2's Complement of a binary number.
4. Implement Binary to Excess-3 Code conversion using Array.
5. Implement Gray Code to Binary Code Conversion & vice versa .
6. Implement Half adder and Half subtractor.
7. Design a BCD adder and carry-look ahead Adder.
8. Design an Adder/Subtracter composite unit .
9. Implement Full adder and Full subtractor.
10. Implement MUX, Decoder, Encoder.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Operating Systems Lab					
Course Code: CSEN3113					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

1. Shell programming [6P]: Creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions and commands).
2. Process [6P]: starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
3. Signal [9P]: signal handling, sending signals, signal interface, signal sets.
4. Semaphore [6P]: programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v.
5. POSIX Threads [9P]: programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)
6. Inter-process communication [9P]: pipes(use functions pipe, popen, pclose), named
7. pipes (FIFOs, accessing FIFO).

Learning Outcomes/Course Outcomes:
Upon the completion of Operating Systems practical course, the student will be able to:

1. Understand and implement basic services and functionalities of the operating system using system calls.
2. Will be able to describe and write shell scripts in order to perform basic shell programming.
3. Will be able to describe and create user defined processes.
4. Understand the benefits of thread over process and implement them.
5. Synchronization programs using multithreading concepts.
6. Use modern operating system calls and synchronization libraries in software to implement process synchronization.
7. Implementation of Inter-process communication using PIPE.

References:

1. Sumitabha Das. Your Unix The Ultimate Guide, MH.
2. Neil Matthew, Richard Stones, Beginning Linux Programming, Wrox.

Subject Name: Computer Architecture Lab					
Paper Code: CSEN 3114					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

VHDL introduction
1. Design digital logic gate (OR, AND, XOR,NOT, NAND, NOR) simulation
2. Implement basic gates using Universal gates.
3. Implement 2's Complement of a binary number.
4. Implement Binary to Excess-3 Code conversion using Array.
5. Implement Gray Code to Binary Code Conversion & vice versa .
6. Implement Half adder and Half subtractor.
7. Design a BCD adder and carry-look ahead Adder.
8. Design an Adder/Subtracter composite unit .
9. Implement Full adder and Full subtractor.
10. Implement MUX, Decoder, Encoder.

11. Implement Flip/Flop(RS, JK, D, T), b)Register,(4/8 bit Synchronized Data Transfer).
12. Design a ripple counter and comparator.
13. Use a multiplexer unit to design a composite ALU.
14. Design a Control Unit.
15. Design a simplified communication protocol.

Course Outcome:

1. After completion of this, students would be able to have adequate knowledge of basics of computer architecture.
2. Students would be able to understand detailed implementation of machine instructions, their classifications and their relevance to programming paradigms.
3. Students would have sufficient knowledge of design implementations of various arithmetic operations such as adder, multiplier etc.
4. Students would be able to design and simulate various combinatorial and sequential logic circuits using Vivado/Xilinx.
5. Students would be able to understand various memory functions.
6. Students would be able to design a formal testbench from informal system requirements.

Course Name : Microprocessors & Microcontrollers Lab					
Course Code: AEIE3115					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

1. Familiarization with 8085A trainer kit components with the process of storing and viewing the contents of memory as well as registers. Repeat the above all using 8085A Simulator.
2. Study of prewritten programs using basic instruction set (data transfer, load/store, arithmetic, logical) on the simulator. Assignments based on above.

3. Programming using kit/simulator for:
   a) Addition/Subtraction of two 8-bit Hex numbers
   b) Packing and unpacking of BCD numbers
   c) Copying and Shifting block of memory
   d) Addition of two 16-bit Hex numbers.
   e) BCD Addition
   f) Multiplication of two 8-bit unsigned numbers using sequential Shift - Add Method.
   g) Binary to ASCII conversion
4. Familiarization of 8086 microprocessor kit/simulator and assembly language programming using 8086 microprocessor/simulator for :
   a) Addition of two 32-bit Hex numbers.
   b) String matching
   c) Shifting a block of data from one memory location to another
   d) Finding the largest/ smallest number from an array
5. Interfacing with switches and LEDs and glowing LEDs according to read switch status and scrolling-
   blinking using delay subroutines through
   a) PPI 8255A with 8085A trainer kit
   b) 8051 microcontroller
6. Interfacing with seven segment displays through 8-bit latch (e.g., 74LS373) using- a) 8085A trainer kit, b)8086A trainer kit and 8255A PPI employing absolute and partial decoding concept as a peripheral mapped output port with absolute address decoding.

Dr. Subhashis Majumder
Professor and HOD

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Detailed Syllabus of 6th Semester:

Course Name : COMPUTER NETWORKS					
Course Code: CSEN3201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Module I: Data Communication Fundamentals and Physical Layer [10L]

(A) **Introduction:** Direction of data flow (simplex, half duplex, full duplex), Network topology, categories of network (LAN, MAN,WAN); [1L]

(B) **Protocols and standards:** Reference models: OSI reference model, TCP/IP reference model, their comparative study [2L]

(C) **Physical Layer:** Digital signal coding, Modulation(Digital and Analog), Multiplexing [1L]

(D) Switching, Telephone Networks [4L]

(E) Transmission Media and its properties; [2L]

Module II: Data Link Layer and MAC Sublayer [13L]

(A) Data link layer Framing / Stuffing, Error detection and correction; [4L]

(B) Flow Control Protocols: Stop-and-Wait / Go-Back-N / Selective Repeat; [3L]

(C) HDLC, PPP [1L]

(D) MAC sub-layer: Ethernet (IEEE 802.3) : ALOHA / CSMA-CD / Collision Resolution, Controlled Access and Channelization methods; [3L]

(E) Devices: Transparent Bridges / Source-Route Bridges / Ethernet Switches ; Backward Learning Algo; Construction of Spanning Trees; Routers. [2L]

Module III: Network layer and Internetworking: [10L]

(A) IPv4: Packet format ; Classful addressing / subnetting / subnet mask; CIDR / supernetting / masks; [3L]

(B) IPv6: address format / packet format / differences with IP (v4); [1L]

(C) Protocols: IP, ICMP, ARP [2L]

(D) Routing algorithm: concept of static and dynamic routing, Distance vector / Link state algo; [2.5L]

(E) Protocols: OSPF, BGP [1.5L]

Module IV: Transport and Application layer [10L]

(A) Transport Layer: Process to process delivery / multiplexing and other services of transport layer [1L]

(B) Transport Layer protocols: TCP: Three way handshaking, Window management, Flow and congestion control with slow start, additive increase, multiplicative decrease; UDP, Difference between UDP and TCP [4L]

(C) General Congestion control algorithm: open and closed loop; Techniques to improve: QoS Leaky bucket / Token bucket. [2L]

(D) Modern Topics: Introduction to wireless LAN and Bluetooth, Mobile IP, Mobile TCP [3L]

Dr. Subhashis Majumdar

Text Books:

1. Andrew S. Tanenbaum: Computer Networks, Pearson Education , fourth edition.
2. William Stallings: Data and Computer Communication, Prentice hall, Seventh edition.
3. William Stallings: High speed Networks and Internets, Pearson education, second edition.

References:

1. William Stallings: Cryptography and Network security PHI, Third edition.
2. William Stallings: ISDN and Broadband ISDN with Frame Relay and ATM.
3. Kurose & Ross: Computer Networking: A Top Down Approach, 5th Ed.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Outcomes/Learning Outcomes:

Upon completion of their academic and internship requirements, graduates of Champlain College's undergraduate Computer Networking Program will:

- Describe and analyze the hardware, software, components of a network and the interrelations.
- Explain networking protocols and their hierarchical relationship hardware and software. Compare protocol models and select appropriate protocols for a particular design.
- Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies.
- Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols and security. Analyze performance of enterprise network systems.
- Use appropriate resources to stay abreast of the latest industry tools and techniques analyzing the impact on existing systems and applying to future situations.

Course Name : Software Engineering					
Course Code: CSEN3202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**3**

<u>Module-1</u>[10L]:

1. Introduction to Software Engineering (3L)
- Software Engineering – objectives and definitions
- Software Life Cycle – different phases
- Lifecycle Models - Waterfall, Relaxed Waterfall, RAD, Prototyping, Incremental, Spiral, Agile
2. Requirements Phase (3L)
- Requirements Collection and Analysis
- Requirement Specifications – General Structure of Software Requirement Specifications (SRS)
- Functional and Non-functional Requirements
- Representing Requirements as Use Cases with examples
3. Structured Analysis Modeling Techniques (4L)
- Process Model using Context Diagrams (CD) and Data Flow Diagram (DFD) with examples
- Data Dictionary, Decision Tree, Decision Table with examples
- Data Model using Entity Relationship Diagram (ERD) with examples

<u>Module-2</u>: [10L]

4. Design Phase (4L)
- Overview – Comparison between Requirement Analysis and Design, Attributes of Good Design
- Define Approaches – Functional and Object Oriented
- Design Aspects – Top-Down and Bottom-Up
- Structured Design – Module Design (or High Level Design), Detail Design (or Low Level Design)
- Functional Decomposition – Abstraction, Cohesion, Coupling, Structure Chart, Structured English
5. Object Oriented Analysis and Design (6L)
- OOAD Basic Concepts
- Unified Modeling Language (UML) – different types of diagrams for different views of system
- User View – Use Case Diagram with examples
- Structural Views – Class Diagram with examples
- Behavioral View – Sequence, Collaboration, Activity and State Chart Diagrams with examples

<u>Module-3</u>: [10L]

6. Coding or Programming (2L)
- Programming Principles and Guidelines – Structured Programming, Code Re-use, Coding Standards / Guidelines
- Coding Process – Incremental Coding, Test Driven Development, Pair Programming / Extreme Programming

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Outcomes/Learning Outcomes:

Upon completion of their academic and internship requirements, graduates of Champlain College's undergraduate Computer Networking Program will:

- Describe and analyze the hardware, software, components of a network and the interrelations.
- Explain networking protocols and their hierarchical relationship hardware and software. Compare protocol models and select appropriate protocols for a particular design.
- Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies.
- Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols and security. Analyze performance of enterprise network systems.
- Use appropriate resources to stay abreast of the latest industry tools and techniques analyzing the impact on existing systems and applying to future situations.

Course Name : Software Engineering					
Course Code: CSEN3202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**3**

Module-1[10L]:

1. Introduction to Software Engineering (3L)
- Software Engineering – objectives and definitions
- Software Life Cycle – different phases
- Lifecycle Models - Waterfall, Relaxed Waterfall, RAD, Prototyping, Incremental, Spiral, Agile

2. Requirements Phase (3L)
- Requirements Collection and Analysis
- Requirement Specifications – General Structure of Software Requirement Specifications (SRS)
- Functional and Non-functional Requirements
- Representing Requirements as Use Cases with examples

3. Structured Analysis Modeling Techniques (4L)
- Process Model using Context Diagrams (CD) and Data Flow Diagram (DFD) with examples
- Data Dictionary, Decision Tree, Decision Table with examples
- Data Model using Entity Relationship Diagram (ERD) with examples

Module-2: [10L]

4. Design Phase (4L)
- Overview – Comparison between Requirement Analysis and Design, Attributes of Good Design
- Define Approaches – Functional and Object Oriented
- Design Aspects – Top-Down and Bottom-Up
- Structured Design – Module Design (or High Level Design), Detail Design (or Low Level Design)
- Functional Decomposition – Abstraction, Cohesion, Coupling, Structure Chart, Structured English

5. Object Oriented Analysis and Design (6L)
- OOAD Basic Concepts
- Unified Modeling Language (UML) – different types of diagrams for different views of system
- User View – Use Case Diagram with examples
- Structural Views – Class Diagram with examples
- Behavioral View – Sequence, Collaboration, Activity and State Chart Diagrams with examples

Module-3: [10L]

6. Coding or Programming (2L)
- Programming Principles and Guidelines – Structured Programming, Code Re-use, Coding Standards / Guidelines
- Coding Process – Incremental Coding, Test Driven Development, Pair Programming / Extreme Programming

- Source Code Version Control, Build, Code Refactoring

7. Review and Testing (8L)

- Self Review / Peer Review
- Testing Overview -- Objective, Definition, Static and Dynamic Testing, Functional vs. Non-functional Testing
- Testing Artifacts – Test Cases and Test Suites, Traceability Matrix , Test Data , Stub and Driver
- Testing Process – Test Case Design, Test Case Execution, Test Result, Defect Logging and Tracking
- Testing Methods -- White Box Testing with Test Coverage using Control Flow Graph (CFG) and Cyclomatic Complexity, Black Box Testing with Equivalence Class Partitioning and Boundary Value Analysis,
- Testing Level – Unit Testing, Integration Testing, System Testing, (User) Acceptance Testing, Regression Testing, Performance Testing, Usability Testing, Non-functional Testing

Module-4:**[10L]**

8. Software Maintenance (2L)

- Types of Maintenance – Corrective, Preventive, Adaptive Change Management and Maintenance Process Software Estimation (3L)

9. Software Estimation (3L)

- Overview of Software Estimation – Size, Effort, Duration and Cost
- Size Estimation Methods – Lines of Code (LOC) and Function Points (FP)
- Estimation of Effort and Duration based on Size and Productivity
- Constructive Cost Model (COCOMO) – Basic COCOMO, Intermediate COCOMO (COCOMO 81), Detailed COCOMO (COCOMO II)

10. Project Management (3L)

- Project Management Overview -- Planning, Staffing, Execution, Monitoring and Control
- Responsibilities of Project Manager
- Project Scheduling – Work Breakdown Structure (WBS) and Gantt Charts

11. Configuration Management (2L)

- Overview of Configuration Management - Identification, Control, Status Accounting, Audits
- Concept of Baseline, Versioning of Configurable Items (CI)

Learning Objectives/Course Outcomes:

1) Knowledge and Understanding of:
   a) the system development lifecycle and associated models;
   b) the software-development process, including requirements analysis, design, coding, testing and maintenance;
   c) the basic principles of function-oriented and object-oriented software development with modular approach
   d) the essentials of software estimation and project planning
   e) the basics of software configuration management
   f) the fundamentals of software project risk management.
2) Ability to:
   a) prepare software requirement specifications as per IEEE guidelines
   b) model function-oriented and object-oriented software systems using industry-standard techniques (e.g., DFD, ERD, UML);
   c) approach testing of software systems in a methodical manner
   d) estimate software size using industry-standard methods (e.g., FPA)
   e) work out software project schedule and staffing plan
   f) identify software project risks and their mitigation approach.

Course Name : Database Management System & Computer Networking					
Course Code: CSEN 3205					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module I: [10L]
Introduction to Database Concepts, File Processing System and Database Management System, DBMS Architecture and Data Independence.
Data Model: Basic Concepts, Entity-Relationship Diagram, Keys, Cardinality, Weak Entity Set.
Introduction to relational algebra & SQL: Operators like select, project, rename, Cartesian product, join, union, intersect, minus, DDL, DML.

Module II: [12L]
Relational Database Design: Functional Dependencies, Normalization: Different anomalies in database designing,1NF, 2NF, 3NF and BCNF, Lossless-Join Decomposition and Dependency Preservation.
Introduction to Transaction Processing Concepts: ACID properties, Serializability and Recoverability.

Module III: [10L] Computer Networking: Introduction, topology, transmission mode, LAN/MAN/WAN, OSI 7 layer Model, Communication Techniques, TCP/IP Protocol Stacks.

Module IV: [10L] Inter Networking, WWW, URLs, search engines, electronic mails, Distributed System, Distributed Database System Concepts.

Text books:
1. Henry F. Korth and Silberschatz Abraham, “Database System Concepts, 4th Ed., McGraw Hill, Computer Science Series.
2. Behrouz A. Forouzan, Data Communications and Networking, 4th Ed., McGraw Hill.

Reference books:
3. Elmasri Ramez and Novathe Shamkant,“Fundamentals of Database Systems”, Pearson.
4. Ramakrishnan: Database Management System, McGraw-Hill.
5. Gray Jim and Reuter Address, “Transaction Processing: Concepts and Techniques”, Moragan Kauffman Publishers.
6. Jain: Advanced Database Management System, CyberTech.
7. Date C. J., “Introduction to Database Management”, Vol. I, II, IIIPearson.
8. Ullman J. D., “Principles of Database Systems”, Galgottia Publication.
9. James Martin, “Principles of Database Management Systems”, 1985, Prentice Hall of India, New Delhi.
10. Ramez Elmasri, Shamkant B.Navathe “Fundamentals of Database Systems”, Pearson.
11. Andrew S. Tanenbaum: Computer Networks, Pearson Education, fourth edition.

Module-III

SPICE: Structure of a SPICE program, active and passive device/element statements, different study like DC analysis, transient analysis and ac analysis statement in SPICE. Plotting and printing statement, input and output Impedance calculation using SPICE, voltage and current controlled components in SPICE. [5L]

Graph theory: Graph of network: Concept of path, tree, tree branch, tree link, loop, tie set and cut set. Incidence Matrix, tie-set Matrix and f-cut set matrix and their properties. Loop currents and node-pair potentials, formulation of loop and node equilibrium equations in view of graph theory. [5L]

Module-IV

Two port networks: Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters and Hybrid parameters. Inter relation between parameters. Inter connection between two port networks. Driving point & transfer impedance & admittance. [5L]

Filter Circuits: Concept of filters, Classification of filters. Analysis of Low pass, High pass, Band pass and Band reject filters using operational amplifier. [5L]

Text Books:

1. Networks and Systems, D. Roy Chowdhury, New Age International Publishers
2. Circuit theory, Dr. Abhijit Chakrabarty, Dhanpat Rai & Co Pvt. Ltd.
3. Network Analysis, Van Valkenburg, Pearson Education .
4. Fundamental of Electric circuit theory, D. Chattopadhay & P.C. Rakshit, S. Chand.

References:

1. Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin,The Mc Graw Hill Company.
2. Modern Network Analysis, F.M.Reza & S.Seely, McGraw Hill.

COURSE OUTCOMES OF CIRCUIT THEORY

- Solve electric circuits containing AC and DC sources applying network theorems
- Apply Laplace transform for transient analysis of electrical circuits
- Solve electric circuits applying concepts of graph theory.
- Apply two port network analysis to calculate open circuit impedance parameter, short circuit admittance parameter, transmission parameter and hybrid parameter
- Circuit Simulation using SPICE
- Familiarization with different filter networks.

Course Name : Computer Networks Lab					
Course Code: CSEN3211					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

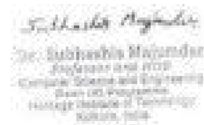
Network Programming Exercises: (To be implemented preferably in Java or C/C++):

1. Getting familiar with the Networking (Socket) API and associated data structures.
2. Implement Simple TCP Client Server Application.
3. Implement TCP Echo Server Client Application.
4. Implement TCP Chat Server Client Application.
5. Implement a File Server Client application.
6. Implement UDP Echo Server Client Application.
7. Implement UDP Time Server Client Application.

8. Implement multithreaded chat program.
9. Implement Web based protocol (looking up URLs, retrieving & examining content, posting a form etc.etc.).
10. Implement Multicasting / Broadcasting socket I/O.
11. Implement Sliding Window Protocol using Non-Blocking I/O (try the Selective Repeat).
12. Implement Secured TCP echo protocol.
13. Experimenting on cross-platform network based communication issues.

Network Hardware / Simulation Exercises:

14. Use of QualNet for Network Modeling. (Basic ideas / demonstration only)
15. Use of Wireshark for Network packet capturing.
16. Creating a small LAN by an Ethernet switch
17. Creating a Wireless LAN using an Access Point



Course Outcomes:

CO 1. Learn the terminology and concepts of network management in Linux platform by understanding shell commands and implementing the same.

CO 2. Understand the concepts of protocols, network interfaces, and design/performance issues through programs.

CO 3. Understanding the need of dividing stream of data into smaller units and implementing program to send such data units across a network.

CO 4. Demonstrate various types of protocols to transfer packets of data from a source to destination machine.

CO 5. Understand the need of different types of Transport Layer Protocols and implement them through socket programming.

CO 6. Learn how to synthesize the learning gathered from different network layers to build useful, relevant and user friendly applications with the objective to solve real life problems.

Course Name : Software Engineering Lab					
Course Code: CSEN3212					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

Exercises and Assignments on:

1. Preparation of SRS for sample application system(s).
2. Preparation of UML Diagrams for sample application problems – Class Diagrams and Sequence Diagrams using tools.
3. Preparation of Test Cases for sample application module(s).
4. Estimation of Project Size for sample application system(s) – Function Point Analysis (FPA).
5. Preparation of Project Schedule and Staffing Plan for sample software project(s) using tools.

Course Outcomes:

a) Students will be able to prepare SRS document for sample application system as per IEEE guidelines.
b) Students will be able to design sample software application problem using various UML diagrams (e.g. Class Diagram, Sequence Diagram etc.) using tools like Microsoft Visio.
c) Students will be able to prepare test cases for sample application module(s).
d) Students will be able to estimate the project size, duration and cost for sample application system using industry standard method like FPA.
e) Students will be able to prepare project schedule and plan the staffing for sample application system.

8. Implement multithreaded chat program.
9. Implement Web based protocol (looking up URLs, retrieving & examining content, posting a form etc.etc.).
10. Implement Multicasting / Broadcasting socket I/O.
11. Implement Sliding Window Protocol using Non-Blocking I/O (try the Selective Repeat).
12. Implement Secured TCP echo protocol.
13. Experimenting on cross-platform network based communication issues.

Network Hardware / Simulation Exercises:

14. Use of QualNet for Network Modeling. (Basic ideas / demonstration only)
15. Use of Wireshark for Network packet capturing.
16. Creating a small LAN by an Ethernet switch
17. Creating a Wireless LAN using an Access Point

Course Outcomes:

CO 1. Learn the terminology and concepts of network management in Linux platform by understanding shell commands and implementing the same.
CO 2. Understand the concepts of protocols, network interfaces, and design/performance issues through programs.
CO 3. Understanding the need of dividing stream of data into smaller units and implementing program to send such data units across a network.
CO 4. Demonstrate various types of protocols to transfer packets of data from a source to destination machine.
CO 5. Understand the need of different types of Transport Layer Protocols and implement them through socket programming.
CO 6. Learn how to synthesize the learning gathered from different network layers to build useful, relevant and user friendly applications with the objective to solve real life problems.

Course Name : Software Engineering Lab					
Course Code: CSEN3212					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

Exercises and Assignments on:

1. Preparation of SRS for sample application system(s).
2. Preparation of UML Diagrams for sample application problems – Class Diagrams and Sequence Diagrams using tools.
3. Preparation of Test Cases for sample application module(s).
4. Estimation of Project Size for sample application system(s) – Function Point Analysis (FPA).
5. Preparation of Project Schedule and Staffing Plan for sample software project(s) using tools.

Course Outcomes:

a) Students will be able to prepare SRS document for sample application system as per IEEE guidelines.
b) Students will be able to design sample software application problem using various UML diagrams (e.g. Class Diagram, Sequence Diagram etc.) using tools like Microsoft Visio.
c) Students will be able to prepare test cases for sample application module(s).
d) Students will be able to estimate the project size, duration and cost for sample application system using industry standard method like FPA.
e) Students will be able to prepare project schedule and plan the staffing for sample application system.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : System Administration Lab					
Course Code: CSEN3213					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

- Introduction to the network environments and different configuration files
- System startup, runlevels and shutdown, file system
- User and group Creation and management with different option and permission
- Packet Monitoring software (tcpdump, ethereal)
- Trace route, Ping, Nmap , netstat
- NFS Configuration
- Firewall Configuration using iptables/ipchains
- Server configuration: FTP, telnet, SMTP, DHCP, HTTP/S, DNS

Course outcomes:

1. Students will demonstrate an understanding of basic knowledge about the installation and configuration of operating systems
2. Students will create different servers in Linux/ Unix System.
3. Students will configure firewall of the system

Course Name : Computer Graphics and Multimedia Lab					
Course Code: CSEN3285					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

- Point plotting, line & regular figure algorithms
- Raster scan line & circle drawing algorithms
- Clipping & Windowing algorithms for points, lines & polygons
- 2-D / 3-D transformations
- Filling algorithms.
- Photo Editing using Photoshop.
- Creating Animation using Flash.

Course Outcomes:

1. Students will demonstrate an understanding of contemporary graphics hardware.
2. Students will create interactive graphics applications in C using one or more graphics application programming interfaces.
3. Students will write programs that demonstrate computer graphics animation.
4. Students will write programs that demonstrate 2D image processing techniques
5. Students will do photo editing using photoshop.
6. Students will create animation in flash.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

List of Electives

OPTIONS FOR ELECTIVE I (Even Semester)
CSEN 3280 Computer Graphics & Multimedia
CSEN 3281 Artificial Intelligence
CSEN 3282 Web technologies
CSEN 3283 Advanced Java Programming

OPTIONS FOR ELECTIVE I Lab* (Even Semester)
CSEN 3285 Computer Graphics & Multimedia Lab
CSEN 3286 Artificial Intelligence Lab
CSEN 3287 Web technologies Lab
CSEN 3288 Advanced Java Programming Lab

Course Name : Computer graphics and multimedia					
Course Code: CSEN3280					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I:
Introduction to computer graphics & graphics systems [6L]: Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.
Scan conversion: [6L]: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

Module II:
2D transformation & viewing [8L]: Basic transformations: translation , rotation, scaling ; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines , parallel lines, intersecting lines. Viewing pipeline, Window to viewport co-ordinate transformation, clipping operations, point clipping , line clipping, clipping circles , polygons & ellipse.
3D transformation & viewing [7L]: 3D transformations: translation, rotation, scaling & other transformations. rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, viewport clipping, 3D viewing.

Module III:
Curves [3L]: Curve representation, surfaces , designs , Bezier curves , B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.
Hidden surfaces [3L]: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Printer's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal - geometry.
Color & shading models [2L]: Light & color model; interpolative shading model; Texture.

Module IV:
Multimedia [10L]: Introduction to Multimedia: Concepts, uses of multimedia, hypertext and hypermedia.; Image, video and audio standards.
Audio: digital audio, MIDI, processing sound, sampling, compression.
Video: MPEG compression standards, compression through spatial and temporal redundancy, inter-frame and intra-frame compression .
Animation: types, techniques, key frame animation, utility, morphing. Virtual Reality concepts.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Learning Outcomes/Course Outcomes:

1. Ability to write program functions to implement graphics primitives.
2. Ability to write programs that demonstrate geometrical transformations.
3. Ability to write programs that demonstrate an understanding of the use of object hierarchy in graphics applications.
4. Ability to write program functions to implement visibility detection.

Text Books:

1. Hearn, Baker – " Computer Graphics (C version 2nd Ed.)" – Pearson education
2. Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
3. D. F. Rogers, J. A. Adams – " Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH
4. Foley, Vandam, Feiner, Hughes – "Computer Graphics principles (2nd Ed.)" – Pearson Education.
5. Ranjan Parekh-"Principles of Multimedia"-TMH

References:

1. Mukherjee, Fundamentals of Computer graphics & Multimedia, PHI
2. Sanhker, Multimedia –A Practical Approach, Jaico
3. Buford J. K. – "Multimedia Systems" – Pearson Education
4. Andleigh & Thakrar, Multimedia, PHI
5. Mukherjee Arup, Introduction to Computer Graphics, Vikas
6. Hill,Computer Graphics using open GL, Pearson Education
7. W. M. Newman, R. F. Sproull – "Principles of Interactive computer Graphics" – TMH.
8. Elsom Cook – "Principles of Interactive Multimedia" – McGraw Hill

<table>
<tr><td colspan="6">Course Name : Artificial Intelligence</td></tr>
<tr><td colspan="6">Course Code: CSEN3281</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
</table>

Module I:

Introduction [1L]: Definition of AI, Intelligent Behavior, Turing Test, Typical AI Problems, Various AI Approaches, Limits of AI.

Introduction to Intelligent Agents [1L]: Agents & environment, Agent Architecture, Agent Performance, Rational Agent, Nature of Environment, Simple Reflex Agent, Goal Based Agent, Utility Based Agent.

Knowledge Representation & Propositional Logic [2L]: Knowledge representation issues, Approaches to knowledge representation, Propositional Logic – its syntax & semantics, Inference rules, Application of those rules, Limitation of Propositional Logic.

Problem Solving using Single Agent Search [2L]: Introduction to State-space search, state-space search notation, search problem, Formulation of some classical AI problems as a state space search problem, Explicit Vs. Implicit State space.

Uninformed Search Techniques [4L]: Basic Principles, Evaluating parameters, BFS, DFS, Depth Limited Search, Iterative Deepening DFS, Uniform Cost Search & Bidirectional Search, Properties of various search methods & their comparative studies.

Module II:

Informed Search Methods [6L]: Basic Principles, Heuristics, Best First Search – Greedy Best First, A* Search, their Properties, Admissible & Consistent heuristic, Local Search Techniques – Hill climbing & Simulated Annealing, Comparison with other methods

Problem Solving using Two Agent Search [2L]: Adversarial Search – Game Tree, MINIMAX Algorithm, Alpha-Beta Pruning, Performance Analysis.

Constraint Satisfaction Problem [2L]: Definition of CSP, Representation of CSP, Formulation of Various popular problems as CSP, Solution methods of CSP – Backtracking & Forward Checking.

Module III:

Knowledge Representation & Predicate Logic [3L]

Syntax & Semantics of FOPL, Representation of facts using FOPL, Clauses, Resolution, Unification methods of inference, Default & Non-Monotonic reasoning.

Knowledge Representation using Rules [2L]

Rule based system, Horn clauses, Procedural vs. declarative knowledge, forward & backward reasoning, Introduction of logic programming using PROLOG/ LISP.

Other Representational Formalism [2L]

Inheritable knowledge, Semantic network, Inference in Semantic network, Extending Semantic Network, Frames, Slots as objects.

Probabilistic reasoning [3L]

Representing knowledge in an uncertain domain, probabilistic inference rules, Bayesian networks – representation & syntax, semantics of Bayesian net, Fuzzy sets & fuzzy logic.

Module IV:

Planning [2L]: Introduction, Simple planning agent, Problem solving vs. planning, Logic based planning, Goal Stack planning, Planning as a search, Total-order vs. partial order planning.

Learning [4L]: Overview, Taxonomy of learning system, various learning models, learning rules, inductive learning framework, Decision tree based learning, Learning using Neural Network & Genetic Algorithm.

Natural Language Processing [2L]: Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.

Expert Systems [2L]: Representing and using domain knowledge, expert system shells, knowledge acquisition.

Course Outcomes/Learning Objectives:

- At the end of this course the students are expected to be capable of understanding the basic features/ attributes that an intelligent system should have, how those attributes can be incorporated to the system.
- Beside this students should be able to know the importance of knowledge as far as intelligence is concerned and how this knowledge can be suitably represented so that it can be used to infer new knowledge.
- On completion of this course, the students also get an idea of the significance of efficient searching algorithms as far as intelligent decisions are concerned.
- Last but not the least, by the end of this course, students will be able to explore various problem solving paradigms, learning algorithms, game playing techniques, logic theorem proving etc.

References:

1. Artificial Intelligence A Modern Approach, Stuart Russell & Peter Norvig, Pearson Education
2. Artificial Intelligence, Ritch & Knight, TMH
3. Artificial Intelligence & Intelligent Systems, N.P.Padhy, Oxford University Press
4. Introduction to Artificial Intelligence & Expert Systems, Dan W. Patterson, PHI
5. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India.

Course Name : Web Technologies					
Course Code: CSEN3282					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

MODULE 1 [Types of Web pages and Web page front end design]

Dynamic Web Pages [1L]

The need of dynamic web pages; comparative studies of different technologies of dynamic page creation

Active Web Pages [1L]

Need of active web pages; java applet life cycle.

HTML (3L):

Module III:

Knowledge Representation & Predicate Logic [3L]

Syntax & Semantics of FOPL, Representation of facts using FOPL, Clauses, Resolution, Unification methods of inference, Default & Non-Monotonic reasoning.

Knowledge Representation using Rules [2L]

Rule based system, Horn clauses, Procedural vs. declarative knowledge, forward & backward reasoning, Introduction of logic programming using PROLOG/ LISP.

Other Representational Formalism [2L]

Inheritable knowledge, Semantic network, Inference in Semantic network, Extending Semantic Network, Frames, Slots as objects.

Probabilistic reasoning [3L]

Representing knowledge in an uncertain domain, probabilistic inference rules, Bayesian networks – representation & syntax, semantics of Bayesian net, Fuzzy sets & fuzzy logic.

Module IV:

Planning [2L]: Introduction, Simple planning agent, Problem solving vs. planning, Logic based planning, Goal Stack planning, Planning as a search, Total-order vs. partial order planning.

Learning [4L]: Overview, Taxonomy of learning system, various learning models, learning rules, inductive learning framework, Decision tree based learning, Learning using Neural Network & Genetic Algorithm.

Natural Language Processing [2L]: Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.

Expert Systems [2L]: Representing and using domain knowledge, expert system shells, knowledge acquisition.

Course Outcomes/Learning Objectives:

- At the end of this course the students are expected to be capable of understanding the basic features/ attributes that an intelligent system should have, how those attributes can be incorporated to the system.
- Beside this students should be able to know the importance of knowledge as far as intelligence is concerned and how this knowledge can be suitably represented so that it can be used to infer new knowledge.
- On completion of this course, the students also get an idea of the significance of efficient searching algorithms as far as intelligent decisions are concerned.
- Last but not the least, by the end of this course, students will be able to explore various problem solving paradigms, learning algorithms, game playing techniques, logic theorem proving etc.

References:

1. Artificial Intelligence A Modern Approach, Stuart Russell & Peter Norvig, Pearson Education
2. Artificial Intelligence, Ritch & Knight, TMH
3. Artificial Intelligence & Intelligent Systems, N.P.Padhy, Oxford University Press
4. Introduction to Artificial Intelligence & Expert Systems, Dan W. Patterson, PHI
5. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India.

Course Name : Web Technologies					
Course Code: CSEN3282					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

MODULE 1 [Types of Web pages and Web page front end design]

Dynamic Web Pages [1L]

The need of dynamic web pages; comparative studies of different technologies of dynamic page creation

Active Web Pages [1L]

Need of active web pages; java applet life cycle.

HTML (3L):

Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue.
Image Maps (1L): map, area, attributes of image area.

MODULE 2 [Web page scripting, server and client side**]**
HTTP[2L]: Message, Request, Response, Methods , Status Codes
Extensible Markup Language (XML) (4L): Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief.
Java Script [3L]
Data types, variables, operators, conditional statements, array object, date object, string ob ject.
Java Servlet [2L]
Servlet environment and role, HTML support, Servlet API, The servlet life cycle, Cookies and Sessions.

MODULE 3 [Advanced Java Server Side Programming**]**
JSP [9L]: JSP architecture, JSP servers, JSP tags, understanding the layout in JSP, Declaring variables, methods in JSP, inserting java expression in JSP, processing request from user and generating dynamic response for the user, using include and forward action, Creating ODBC data source name, introduction to JDBC, prepared statement and callable statement.
J2EE[4L]: An overview of J2EE web services, basics of Enterprise Java Beans, EJB vs. Java Beans

MODULE 4 [Network Security**]**
Threats (1L):
Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks.
Network security techniques (2L):
Password and Authentication; VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH).
Firewall (1L): Introduction, Packet filtering, Stateful, Application layer, Proxy.

References:

1. Web Technology: A Developer's Perspective, N.P.Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Chapters 1-5,7,8,9).
2. Internetworking Technologies, An Engineering Perspective, Rahul Banerjee, PHI Learning, Delhi, 2011.(Chapters 5,6,12)
3. Murach's Java Servlets and JSP.
4. Java for the Web with Servlets, JSP, and EJB, Budi. Kurniawan
5. Cryptography and Network security by William Stallings

Course Outcome:
1. Students will be able to understand the basic tags of HTML, CSS, java script and DHTML.
2. Students will be able to connect a server side program using servlet and JSP to a DBMS and perform insert, update and delete operations on DBMS table.
3. Students will be able to write a server side programming using servlet and JSP to store the data sent from client, process it and store it on database.
4. 4. Students will be able to prepare a well formed / valid XML document , schema to store and transfer data.
5. 5. Students will be able to understand various types of attacks and their characteristics.
6. 6. Students will be able to get familiar with network security designs using available secure solutions (such as PGP, SSL, IPSec)

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Advanced Java Programming					
Course Code: CSEN3283					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I:

Client & server side programming.

Enterprise architecture styles: Single tier, 2-tier , 3-tier, n-tier; Relative comparison of the different layers of architectures.

MVC Architecture: Explanation, Need, Drawbacks, J2EE WEB SERVICES, Different components & containers. [4L].

Module II:

Servlet: Introduction, Advantages over CGI, How it works?, Servlet life cycle, Servlet API (Different interfaces & classes of generic servlet & HTTP servlet), Accessing user information by means of Request & Response, Servlet session management techniques and relative comparison. [4L]

JSP: Introduction, Comparison between JSP & servlet., Architecture/Life cycle, Different types of JSP architectures and relative comparison.; JSP tags ,Directives, Scripting elements, Actions; JSP implicit objects, Accessing user information using implicit objects. [5L]

EJB :Introduction, Comparison of EJB & Java Beans , Applications, Drawbacks, Different types of enterprise beans,Services provided by EJB container. [5L].

Module III:

RMI: Introduction and applications, Architecture ,Use of RMI Registry.

JNDI: Introduction and applications, Comparison between LDAP and JNDI

JDO (Java Data Objects): Introduction, Integration of EJB and JDO, JDO & RMI

JINI :Introduction, Applications [5L]

JDBC: Introduction, Database driver ,Different approaches to connect an application to a database server, Establishing a database connection and executing SQL statements, JDBC prepared statements, JDBC data sources. [5L].

Module IV:

XML: Java & XML, XML syntax, Document type definition., Parsers, SAX parsers, DOM parsers, SAX vs. Dom,

JAXP and JAXB. [8L].

Text Books:

1. "Professional JAVA Server Programming", Allamaraju and Buest ,SPD Publication
2. "Beginning J2EE 1.4" Ivor Horton, SPD Publication.
3. "Advanced Programming for JAVA 2 Platform" Austin and Pawlan, Pearson

References:

1. Internet & Java Programming by Krishnamoorthy & S. Prabhu(New Age Publication)

Course Outcome:

Students will be able to:

CO 1: Understand evolution of Client/Server Computing to access desktop vs web application.

CO 2 : Understand various Architecture patterns used for web application.

CO 3 : Understand the common problems faced in architecting large scale applications and analyze the requirement for applying Java EE components at various level.

CO 4 : Learn various Java EE components and apply them for developing multilayered web application.

CO 5: Learn and use various components (JNDI, EJB) used for distributed processing in Java EE.

CO 6 : Understand and use XML for data transfer

CO 7: Understand database handling in web application using Java EE components (servlets, JSP)

CO 8: Apply various Java EE components for developing a database driven web application using MVC pattern.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : System Administration Lab					
Course Code: CSEN3213					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

- Introduction to the network environments and different configuration files
- System startup, runlevels and shutdown, file system
- User and group Creation and management with different option and permission
- Packet Monitoring software (tcpdump, ethereal)
- Trace route, Ping, Nmap , netstat
- NFS Configuration
- Firewall Configuration using iptables/ipchains
- Server configuration: FTP, telnet, SMTP, DHCP, HTTP/S, DNS

Course outcomes:

1. Students will demonstrate an understanding of basic knowledge about the installation and configuration of operating systems
2. Students will create different servers in Linux/ Unix System.
3. Students will configure firewall of the system

Course Name : Computer Graphics and Multimedia Lab					
Course Code: CSEN3285					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

- Point plotting, line & regular figure algorithms
- Raster scan line & circle drawing algorithms
- Clipping & Windowing algorithms for points, lines & polygons
- 2-D / 3-D transformations
- Filling algorithms.
- Photo Editing using Photoshop.
- Creating Animation using Flash.

Course Outcomes:

1. Students will demonstrate an understanding of contemporary graphics hardware.
2. Students will create interactive graphics applications in C using one or more graphics application programming interfaces.
3. Students will write programs that demonstrate computer graphics animation.
4. Students will write programs that demonstrate 2D image processing techniques
5. Students will do photo editing using photoshop.
6. Students will create animation in flash.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Artificial Intelligence Lab					
Course Code: CSEN3286					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

In this laboratory students will be familiarized with PROLOG/ LISP language. A tentative outline for this laboratory is given below:

- Introduction to PROLOG facts & rules with the help of a simple family tree; how the goals are given in PROLOG; some simple queries on the family tree
- Formation of recursive definition; how PROLOG executes the goals; simple assignments
- How PROLOG deals with problems with numbers – integers, real; with some examples
- Introduction to LIST structure; how PROLOG implements LIST; some simple assignments on LIST.
- Some more complex assignments on LIST; Introduction of Accumulators – simple assignments
- Introduction to CUT with simple assignments; implementation of Sorting algorithms
- PROLOG clauses for file operation – with simple assignments
- Implementation of Graph Search algorithms like DFS, BFS; Some application of DFS & BFS
- Implementation of some well known puzzles, like 8-queens problem, Towers-of-Hanoi problem, Missionaries & Cannibals problem etc..
- Introduction to LISP
- Some simple assignments on LISP.

Course Outcomes/Learning Objectives:
At the end of this course, students are expected to get a good flavor of logical programming by using PROLOG/ LISP. Students should be able to apply those knowledge to solve some intelligent puzzles.

Course Name : Web Technologies Lab					
Course Code: CSEN3287					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

HTML:

A) A) Designing a web page with HTML.
B) B) Designing HTML Form.
C) C) Designing with CSS

Java Script :

A) Data types, variables, operators, conditional statements, array object, date object, string object.
B) Validate the fields of a form using JavaScript

XML :

A) How to write a XML document.
B) How to validate XML document.

Java Servlet :

A) Servlet environment and role
B) HTML support
C) Cookies and Sessions.

JSP :

A) JSP tags, layout in JSP, Declaring variables, methods in JSP
B) Inserting java expression in JSP, processing request from user and generating dynamic response for the user, inserting applets and java beans into JSP, using include and forward action
C) Creating ODBC data source name.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Artificial Intelligence Lab					
Course Code: CSEN3286					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

In this laboratory students will be familiarized with PROLOG/ LISP language. A tentative outline for this laboratory is given below:

- Introduction to PROLOG facts & rules with the help of a simple family tree; how the goals are given in PROLOG; some simple queries on the family tree
- Formation of recursive definition; how PROLOG executes the goals; simple assignments
- How PROLOG deals with problems with numbers – integers, real; with some examples
- Introduction to LIST structure; how PROLOG implements LIST; some simple assignments on LIST.
- Some more complex assignments on LIST; Introduction of Accumulators – simple assignments
- Introduction to CUT with simple assignments; implementation of Sorting algorithms
- PROLOG clauses for file operation – with simple assignments
- Implementation of Graph Search algorithms like DFS, BFS; Some application of DFS & BFS
- Implementation of some well known puzzles, like 8-queens problem, Towers-of-Hanoi problem, Missionaries & Cannibals problem etc..
- Introduction to LISP
- Some simple assignments on LISP.

Course Outcomes/Learning Objectives:
At the end of this course, students are expected to get a good flavor of logical programming by using PROLOG/ LISP. Students should be able to apply those knowledge to solve some intelligent puzzles.

Course Name : Web Technologies Lab					
Course Code: CSEN3287					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

HTML:

A) A) Designing a web page with HTML.

B) B) Designing HTML Form.

C) C) Designing with CSS

Java Script :

A) Data types, variables, operators, conditional statements, array object, date object, string object.

B) Validate the fields of a form using JavaScript

XML :

A) How to write a XML document.

B) How to validate XML document.

Java Servlet :

A) Servlet environment and role

B) HTML support

C) Cookies and Sessions.

JSP :

A) JSP tags, layout in JSP, Declaring variables, methods in JSP

B) Inserting java expression in JSP, processing request from user and generating dynamic response for the user, inserting applets and java beans into JSP, using include and forward action

C) Creating ODBC data source name.

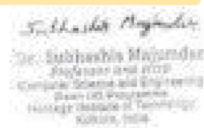
COURSE STRUCTURE OF B. TECH IN
COMPUTER SCIENCE & ENGINEERING, HIT

Course Outcome:

1. Students will be able to **understand** the basic tags and properties to write client side and server side programming.
2. Students will be able to **develop** static and dynamic webpage by the use of HTML/CSS, java script and DHTML.
3. Students will be able to **connect** a server side programs using servlet and JSP to a DBMS and **perform** insert, update and delete operations on DBMS table.
4. Students will be able to **write** a server side programming using servlet and JSP to store the data sent from client, process it and store it on database.
5. Students will be able to **select** required HTML tags and CSS properties and java scripts to design a particular web page.
6. Students will be able to **prepare** a well formed / valid XML document , schema to store and transfer data.

Course Name : Advanced Java Programming Lab					
Course Code: CSEN3288					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

Java Data Base Connectivity: A Data Base can be accessed from program.
Servlets: Development of web based components.
Java Beans: Using EJB , programmer should visually assemble components and dynamically change properties.
Java Server Pages: Programs to implement to dynamically generate HTML, XML or other types of documents in response to a Web client request.
Remote Method Invocation: Programs to provide the mechanism by which the server and the client communicate and pass information back and forth.



Course Outcome:
CO 1: Students will be able to develop dynamic web pages using servlet, JSP, EJB
CO 2: Students will be able to access Data using JDBC from dynamic web page
CO 3: Students will be able to process data using XML

Syllabus of Sessional Course

Course Name : Seminar I					
Course Code: CSEN3297					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**3**	**3**	**2**

Seminar on recent topics related to Computer Science & Engineering.
Course outcomes/Learning objectives:

- Students will demonstrate the ability to prepare appropriately to participate effectively in class discussion.
- Students will demonstrate the ability to follow discussions, oral arguments, and presentations, noting main points or evidence and tracking threads through different comments.
- Further, students will be able to challenge and offer substantive replies to others' arguments, comments, and questions, while remaining sensitive to the original speaker and the classroom audience.
- Students will learn to prepare materials on a topic relevant to the course and demonstrate critical faculties with the text discussed.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Outcome:

1. Students will be able to **understand** the basic tags and properties to write client side and server side programming.
2. Students will be able to **develop** static and dynamic webpage by the use of HTML/CSS, java script and DHTML.
3. Students will be able to **connect** a server side programs using servlet and JSP to a DBMS and **perform** insert, update and delete operations on DBMS table.
4. Students will be able to **write** a server side programming using servlet and JSP to store the data sent from client, process it and store it on database.
5. Students will be able to **select** required HTML tags and CSS properties and java scripts to design a particular web page.
6. Students will be able to **prepare** a well formed / valid XML document , schema to store and transfer data.

Course Name : Advanced Java Programming Lab					
Course Code: CSEN3288					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**0**	**3**	**3**

Java Data Base Connectivity: A Data Base can be accessed from program.
Servlets: Development of web based components.
Java Beans: Using EJB , programmer should visually assemble components and dynamically change properties.
Java Server Pages: Programs to implement to dynamically generate HTML, XML or other types of documents in response to a Web client request.
Remote Method Invocation: Programs to provide the mechanism by which the server and the client communicate and pass information back and forth.

Course Outcome:
CO 1: Students will be able to develop dynamic web pages using servlet, JSP, EJB
CO 2: Students will be able to access Data using JDBC from dynamic web page
CO 3: Students will be able to process data using XML

Syllabus of Sessional Course

Course Name : Seminar I					
Course Code: CSEN3297					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**3**	**3**	**2**

Seminar on recent topics related to Computer Science & Engineering.
Course outcomes/Learning objectives:

- Students will demonstrate the ability to prepare appropriately to participate effectively in class discussion.
- Students will demonstrate the ability to follow discussions, oral arguments, and presentations, noting main points or evidence and tracking threads through different comments.
- Further, students will be able to challenge and offer substantive replies to others' arguments, comments, and questions, while remaining sensitive to the original speaker and the classroom audience.
- Students will learn to prepare materials on a topic relevant to the course and demonstrate critical faculties with the text discussed.

Dr. Subhashis Majumdar

Course Name : Operating Systems Concepts					
Course Code: INFO3101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

After successfully completing this course the students will be able to:

(1) Analyze and differentiate between different types of operating systems (namely, batch, multi-programmed, time-sharing, real-time, distributed, parallel processing system) based on their application domains and evolution.

(2) Demonstrate and describe system operations, internal structure of computer system and operating system.

(3) Design multiprocessing and multithreading environments based on inter-process/thread communication and synchronization.

(4) Compare the different level of memory (Primary memory, cache, virtual memory, secondary storage) and how they are correlated to improve the performance of the system.

(5) Demonstrate the operations of IO devices and how they are governed by the operating system

(6) Discuss the activity and impact of threat, virus, worm and how the system could be protected from them.

Detailed Syllabus:

Module - I (10L)

Introduction [4L] : Introduction to OS. Operating system functions, evaluation of O.S., Different types of O.S.: batch, multi-programmed, timesharing, real-time, distributed, parallel.

System Structure[3L] : Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services, and system calls.

Process and Threads (3L) :

Processes [1L]: Concept of processes, operations on processes.

Threads [2L]: overview, benefits of threads, user and kernel threads.

Module - II (14L)

Process Scheduling(2L): Process scheduling, co-operating processes, inter process communication.

CPU scheduling [3L]: scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling.

Process Synchronization [5L]: background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.

Deadlocks [4L]: system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

Module III (11L)

Memory Management [5L]: background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.

Virtual Memory [3L]: background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing.

Disk Management [3L]: disk structure, disk scheduling (FCFS, SSTF, SCAN,C-SCAN) , disk reliability, disk formatting, boot block, bad blocks.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Module IV(12L)

File Systems [4L]: file concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance.

I/O Management [4L]: I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and non blocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.

Protection & Security [4L]

Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.

References:

1. Milenkovie M., “Operating System : Concept & Design”, McGraw Hill.
2. Tanenbaum A.S., “Operating System Design & Implementation”, Practice Hall NJ.
3. Silbersehatz A. and Peterson J. L., “Operating System Concepts”, Wiley.
4. Dhamdhere: Operating System TMH
5. Stalling, William, “Operating Systems”, Maxwell McMillan International Editions, 1992.
6. Dietel H. N., “An Introduction to Operating Systems”, Addison Wesley.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Computer Architecture					
Course Code: INFO3102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) Review of basic computer architecture, Quantitative techniques in computer design, measuring and reporting performance.

(2) Classify different kinds of pipeline, pipeline hazards and suggesting suitable remedial techniques to handle the hazards. Discussing different kinds of parallel architectures (Flynn's Classification), types of Multiprocessor architectures (UMA, NUMA, COMA and NORMA), types of Inter connection (Bus, Hypercube and Omega) network and Memory Consistency models. Explaining the concepts of Centralized shared memory architecture and Distributed shared memory architecture.

(3) Compute performance parameters of pipelines (Speed-up, Efficiency and Throughput) and deduce derivations to demonstrate the performance parameters when branching effect is introduced. Pipeline optimization techniques needs to be illustrated. Preparing numerical module based on pipeline concepts.

(4) Differentiate between different Memory technologies (Primary, Secondary and Cache) and helping students to compute different kinds of numerical based on the memory technologies.

(5) Collecting knowledge about Superscalar, Super pipelined and VLIW processor architectures, Array and vector processors. Constructing the concepts of ILP.

(6) Comparing different techniques of ILP (Loop Unrolling, Dynamic Scheduling and Software Pipelining) and concluding with concepts of Data Flow architecture, RISC, CISC and Systolic architecture

Detailed Syllabus:

Module – 1: [12 L]

Introduction: Review of basic computer architecture (Revisited), Quantitative techniques in computer design, measuring and reporting performance. (4L)

Pipelining: Basic concepts, Instruction pipeline, Arithmetic pipeline, processor pipeline, Data hazards, Control hazards and Structural hazards, Techniques for handling hazards, Static scheduling vs Dynamic scheduling, Pipeline optimization technique. (8L)

Module – 2: [8L]

Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, Mapping and management techniques, Memory replacement policies.

Module – 3: [8L]

Instruction-level parallelism: Basic concepts, techniques for increasing ILP, Superscalar, Super-pipelined and VLIW processor architectures. Array and vector processors. Design of Control Unit.

Module – 4: [12 L]

Multiprocessor architecture: Taxonomy of parallel architectures; Centralized shared- memory architecture, Memory consistency models, Interconnection networks. Distributed shared-memory architecture. Cluster computers. (8L)

Non von Neumann architectures: Data flow computers, RISC and CISC architecture, Systolic architectures. (4L)

References:

1) Advanced Computer Architecture by Kai Hwang.
2) Computer Architecture: A Quantitative approach- Patterson and Hennessy.
3) Computer Architecture and Parallel processing- Hwang and Briggs.
4) Computer Architecture by T.K.Ghosh.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Software Engineering & Project Management					
Course Code: INFO3103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

1. At the end of the course student should gather the knowledge of the system development lifecycle;
2. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, health and manufacturability.
3. Acquire Knowledge of the principles of object-oriented software construction.
4. Acquire knowledge to manage a project including planning, scheduling and risk assessment.

Detailed Syllabus:

Module-I: [10L]
Principles and Motivations:
Definitions and need for engineered approach to software development; software Development process models from the points of view of technical development and project management: waterfall, rapid prototyping, incremental development, spiral model.
Design of Software Systems: System Design: Context diagram and DFD, Cohesion, Coupling, Problem Partitioning, Top-Down And Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.

Module-II: [10L]
Software Testing:
Testing Levels of Testing, Black Box Testing ,White Box Testing ,Integration Testing ,System Testing, Validation Testing ,Test case Specification, Reliability Assessment, Validation & Verification Metrics, Monitoring & Control ,Case Tools ,Classification ,Features ,Strengths And Weaknesses; Icase; CASE Standards.Formal Methods of Software Development.
Module-III: [10L]
Software Project Management:
Principles of software projects management; organizational and team structure; project planning; project scheduling, project initiation and project termination; technical, quality, and management plans; Software Quality Assurance, Software Configuration Management ,Risk analysis and Management ,project control; cost estimation methods - function points and COCOMO.

Module-IV: [10L]
Object Modeling and Design:
UML Fundamentals, Structural Diagram, Behavioral Diagram, Classes, objects, relationships, key abstractions, class diagrams, message, Sequence diagrams, use cases, use case diagrams, activity diagrams, States, Events, Actions, State Chart Diagram.

References:

1. Roger pressman; software engineering - a practitioner's approach, McGraw hill, New York.
2. Ian sommerville; software engineering, addison-wesley publishing company, England
3. Pankaj Jalote; an integrated approach to software engineering, Narosa publishing House, New Delhi.
4. Grady Booch, James Rumbaugh, Ivar Jacobson, the unified modeling language User guide, Pearson education, New York

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : DBMS					
Course Code: INFO3104					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	4	**0**	**0**	**4**	**4**

<u>After successfully completing this course the students will be able to:</u>

1.Evaluation:- Justify the need of DBMS over traditional file system and analyze the overall database description, at three levels, namely, internal, conceptual, and external levels.

2.Evaluation: Deduce the constraints , i.e., the candidate keys, superkeys, that exists in a given real world problem and design the entity relationship diagram to graphically represent entities and their relationships to each other, typically used in computing in regard to the organization of data within databases or information systems

3.Synthesis : Formulate a mathematical tool using relational algebra that operates on one or more relational tables and outputs a relational table as result, and design a normalized Database based on real-world situations, maintaining all constraints and manipulate database relations using SQL and PL/SQL

4.Evaluation: Prove if a schedule A is conflict serializable with schedule B then it is also view serializable with schedule B but vice versa is not true.

5.Evaluation : Compare the number of block access required for searching a particular record in a data file having (primary index , secondary index, multilevel index.).

<u>Detailed Syllabus:</u>

<u>Module 1:</u> Introduction and Conceptual Modeling [7L]

Database Model, Schema and architecture : [2L]

Concept & Overview of database and DBMS, Advantages of using DBMS approach, Database Users , Database Administrator, Database applications. Data Models and its categories, Schema, Instances, Database Languages, Three Schema architecture of DBMS, Data independence, Centralized and client server architecture for DBMS. Classification of DBMS. Introduction to big data.

Entity-Relationship Model : [5L]

Basic concepts, Design Issues, Cardinality, SuperKeys, Candidate keys, Entity types, Entity sets, attributes and keys. Relationship types, Relationship sets, Attributes of relationship types, Weak Entity Sets , ER diagram design issues, Extended E-R modeling: generalization, specialization, aggregation.

<u>Module 2 :</u>Relational Model: Languages and query processing [13L]

Introduction to relational model: [1L]

Concepts of domains, attributes, tuples, relations. Transformation of ERD model to relational model.

Relational Algebra and Calculus: [5L]

Operators in relational algebra: select, project, rename, cartesian product, different types of join, Division,Intersect, Union, Minus. Tuple relational calculus, Domain relational calculus.

Introduction to Database languages [4L]

SQL: Concept of DDL, DML, DCL,TCL,DQL. Query structure, concept of subquery, group functions. View. PL/SQL basic structure, Control structure, Cursor,Triggers.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

<u>Module 3</u> : Relational Database Design **[13L]**

Database integrity : **[1L]**

Domain constraints, entity integrity, referential integrity constraints. Concept of null and not null constraint

Functional Dependencies: **[3L]**

Basic concept of functional dependency, Axioms, Closure, Attribute closure, Equivalent set of FD, Cover, Canonical cover.

Normalization : **[8L]**

Concept of Super keys, Candidate keys. Determining candidate keys from FD. Different anomalies in designing a Database. First, second and third normal form, Boyce-Codd Normal Form, Nomalization using multi-valued depedencies and join dependency. Dependency preservation, Lossless decomposition.

<u>Module 4 :</u> Transaction Processing , Data Storage **[13L]**

Transaction processing concepts **[8L]**

Transaction properties, states, serial vs. concurrent execution, Serializability, Concurrency control techniques, and Recovery Management

File Organization & Index Structures **[5L]**

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree .

References:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
2. Elmasri Ramez and Navathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.
3. Date C. J., "Introduction to Database Management", Vol. I, II, III, Addison Wesley.
4. Ramakrishnan: Database Management System , McGraw-Hill
5. Gray Jim and Reuter Address, "Transaction Processing : Concepts and Techniques", Moragan Kauffman Publishers.
6. Jain: Advanced Database Management System CyberTech
7. Ullman JD., "Principles of Database Systems", Galgottia Publication.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Communication Theory					
Course Code: INFO3131					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>After successfully completing this course the students will be able to:</u>

(1) The students will have concepts about communication – wireless and line.

(2) Will be able to differentiate between AM, FM.

(3) Will form ideas about data rate, bandwidth, and channel.

(4) Will practically see and measure the key parameters like deviation, clock rate etc.

<u>Detailed Syllabus:</u>

Module1: [Elements of communication system] [12]

The elements of a communication system, origin of noise and its effect, Importance of SNR in system design. Basic principle of linear (AM) modulation, Generation of AM waves, Demodulation of AM wave. Basic principle of nonlinear (FM, PM) modulation. Generation of FM waves. Demodulation of FM waves. Sampling theorem, sampling rate, impulse sampling, reconstruction from samples, Aliasing. Analog pulse modulation-PAM (natural & flat topped sampling), PWM, PPM. Basic concept of Pulse code modulation, Block diagram of PCM, Multiplexing-TDM, FDM.

Module2: [**Digital transmission] [7]**

Concept of Quantization & Quantization error, Uniform quantizer, Non-uniform quantizer, A-law and μ-law. Encoding, coding efficiency. Line coding & properties, NRZ & RZ, AMI, Manchester coding, PCM, DPCM. Base band pulse transmission, Matched filter, error rate due to noise, Nyquist criterion for distortion-less base band binary transmission, Signal power in binary and digital signal.

Module3: [**Digital carrier modulation & demodulation technique**] **[10]**

Bit rate, Baud rate, Information capacity, Shanon's limit, Introduction to the different digital modulation techniques-ASK, FSK, PSK, BPSK, QPSK. Introduction to QAM, Basic concept of Delta modulating, Adaptive delta modulation. Introduction to the concept DPCM. Basic concept of spread spectrum modulation.

Module4: [Introduction to coding theory] [6]

Introduction, News value & Information content, Entropy, Mutual information, Information rate, Shanon-Fano algorithm for encoding, Shanon's theorem- source coding theorem. Basic principle of Error control & coding.

References:

1. An Introduction to Analog and Digital communication, Simon Haykin, Wiely India.
2. Analog communication system, P. Chakrabarti, Dhanpat Rai & Co.
3. Principle of digital communication, P. Chakrabarti, Dhanpat Rai & Co.
4. Modern Digital and Analog Communication systems, B.P. Lathi, Oxford University press

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Compiler Design					
Course Code: INFO3132					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) Describe the theory and practice of compilation, in particular the lexical analysis, syntax, and semantic analysis, code generation and optimization phases of compilation.
(2) Create lexical rules and grammars for a programming language.
(3) Use Flex or similar tools to create a lexical analyzer and Yacc/Bison tools to create a parser.
(4) Design a compiler for a concise programming language.
(5) Implement a lexer without using Flex or any other lexer generation tools.
(6) Implement a parser such as a bottom-up SLR parser without using Yacc/Bison or any other compiler-generation tools.
(7) Implement semantic rules into a parser that performs attribution while parsing.

Detailed Syllabus:

Module I: [9L]
Introduction to Compiling *[3L]*
Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler.
Lexical Analysis *[6L]*
The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex).

Module II: [14L]
Syntax Analysis *[9L]*
The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non-recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.
Syntax directed translation *[5L]*
Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.

Module III: [13L]
Type checking *[4L]*
Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions
Run time environments *[5L]*
Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.
Intermediate code generation *[4L]*
Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Module IV: [9L]

Code optimization *[5L]*

Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization.

Code generations *[4L]*

Issues in the design of code generator, a simple code generator, Register allocation & assignment.

References:

1. Aho, Sethi, Ullman - "Compiler Principles, Techniques and Tools" – Pearson Education.
2. Holub - "Compiler Design in C" - PHI.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Discrete Mathematics					
Course Code: INFO3133					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

This course introduces the applications of discrete mathematics inthe field of computer science. It covers sets, logic, provingtechniques, combinatorics, functions, relations, graph theory and algebraic structures. These basic concepts of sets, logic functionsand graph theory are applied to Boolean Algebra and logicnetworks, while the advanced concepts of functions and algebraicstructures are applied to finite state machines and coding theory.

Detailed Syllabus:

Module I [10L]:
Introduction to Propositional Calculus: Propositions, Logical Connectives, Conjunction, Disjunction, Negation and their truth table. Conditional Connectives, Implication, Converse, Contrapositive, Inverse, Biconditional statements with truth table, Logical Equivalence, Tautology, Normal forms-CNF, DNF; Predicates and Logical Quantifications of propositions and related examples.

Module II [10L]:
Theory of Numbers: Well Ordering Principle, Divisibility theory and properties of divisibility; Fundamental theorem of Arithmetic; Euclidean Algorithm for finding G.C.D and some basic properties of G.C.D with simple examples; Congruences, Residue classes of integer modulo and its examples. Order, Relation and Lattices: POSET, Hasse Diagram, Minimal , Maximal, Greatest and Least elements in a POSET, Lattices and its properties, Principle of Duality, Distributive and Complemented Lattices.

Module III [10L]:
Counting Techniques: Permutations, Combinations, Multinomial Theorem, Binomial coefficients, Pigeon- hole Principle, Principles of inclusion and exclusions; Recurrence relations: Formulation/Modelling of different counting problems in terms of recurrence relations, Solution of linear recurrence relations with constant coefficients (upto second order) by (i) The iterative method (ii) Characteristic roots method (iii) Generating functions method.; Ramsey Problem on Counting techniques.

Module IV [6L]:
Dual Graph and its construction, Planar Graph & Testing for Planarity of a Graph, Cut Set & Cut Vertices; Graph Coloring: Chromatic Numbers and its bounds, Independence and Clique numbers, Perfect Graphs-Definition and examples, Chromatic polynomial and its determination, Applications of Graph Coloring Matchings: Definitions and Examples of Perfect Matching, Maximal and Maximum Matching, Hall's Marriage Theorem (Statement only) and related problems.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

References:

1. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation
2. J.L. Mott, A. kandel and T. P. Baker: Discrete Mathematics for Computer Scientist, reston, Virginia, 1983.
3. C. L. Liu: Elements of Discrete Mathematics, 2nd ed., McGraw Hill, New Delhi, 1985.
4. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI.
5. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
6. N. Deo :Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, Englewood Cliffs,1974.
7. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH
8. J.K. Sharma, Discrete Mathematics, Macmillan
9. Winfried Karl Grassmann and Jean-Paul Tremblay, Logic and Discrete Mathematics, PEARSON.
10. R. A. Brualdi: Introductory Combinatorics, North Holland, New York, 1977.
11. F. S. Roberts: Applied Combinatorics, Prentice Hall, Englewood Cliffs, NJ, 1984.
12. Reingold et al.: Combinatorial Algorithms: Theory and Practice, Prentice Hall, Englewood Cliffs,1977.
13. S. K. Chakraborty and B. K. Sarkar, Discrete Mathematics, OXFORD University Press.
14. Douglas B. West, Introduction to graph Theory, PHI

Course Name : UNIX & Operating Systems Laboratory					
Course Code: INFO3111					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

(1) Develop shell scripts to manage the system memory, user, files, and devices.

(2) Develop multi-processing and multi-threading environment capable of performing multiple tasks or sub-tasks simultaneously.

(3) Apply system calls and signals for user defined purposes

(4) Design a synchronized multi-threaded system capable of resource sharing

(5) Develop C programs to share information between two process using concepts of IPC.

Detailed Syllabus:

1. Managing Unix/Linux Operating System [8P]:
Creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands). Partitions, Swap space, Device files, Raw and Block files, Formatting disks, Making file systems, Superblock, I-nodes, File system checker, Mounting file systems, Logical Volumes, Network File systems, Backup schedules and methods Kernel loading, init and the inittab file, Run-levels, Run level scripts. Password file management, Password security, Shadow file, Groups and the group file, Shells, restricted shells, user-management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users & user groups.

2. **Process [4P]:** starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.

3. **Signal [4P]:** signal handling, sending signals, signal interface, signal sets.

4. **Semaphore [6P]:** programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).

5. **POSIX Threads [6P]:** programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)

6. **Inter-process communication [6P]:** pipes(use functions pipe, popen, pclose), named pipes(FIFOs, accessing FIFO), message passing & shared memory(IPC version V).

References:

1. Behrouz A. Forouzan, Richard F. Gilberg, UNIX and Shell Programming, Thomson, 2003.
2. Brian W. Kernighan, Rob Pike, The UNIX Programming Environment, PHI, 1996.
3. K. Srirengan, Understanding UNIX, PHI, 2002.
4. Sumitabha Das, Your UNIX- The Ultimate Guide, TMGH, 2002.
5. Sumitabha Das, UNIX Concepts and Applications, Second Edition, TMGH, 2002.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Computer Architecture Laboratory					
Course Code: INFO3112					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

(1) Discuss HDL introduction and explain the working of VHDL Simulator.

(2) Demonstration of the following Lab Assignments are undertaken in the lab:

Adder (Full & Half), Subtractor (Full & Half), Code Conversion (Binary to Gray & Gray to Binary), Decoder (3:8), Mux (4:1 & 8:1), Flip-flops (T, SR, JK & D), ALU design (8 bit), and Asynchronous Binary Up/Down Counter.

(3) Designing Truth table, KMap and Timing Diagram for all lab assignments.

Detailed Syllabus:

Lab 1: Data flow approach:

Write vhdl code for and, or, not, nand, xor, xnor, nor gates using data flow approach.

Lab 2: Behavioral flow approach:

Write vhdl code for and, or, not, nand, xor, nor, xnor gates using behavioral flow approach.

Lab 3: Adder and subtractor:

Write vhdl code for half adder, full adder, half subtractor and full subtractor using data flow approach & behavioral approach.

Lab 4: Structural approach:

Write vhdl code for half adder, full adder, half subtractor and full subtractor using structural approach.

Lab 5: Array:

Write vhdl code to implement 2's complement and excess three of a four bit number using array.

Lab 6: Binary-gray converter:

Write vhdl code for binary to gray code and vice-versa by data flow approach & behavioral approach.

Lab 7: Decoder and multiplexer:

Write vhdl code to implement 3-8 line decoder and 2:1 mux using data flow approach & behavioral approach.

Lab 8: Flipflop:

Write vhdl codes for d-flipflop, t-flipflop and sr-flipflop using data flow approach and behavioral approach.

Lab 9: ALU design:

Design and implement 4 bit alu and 8 bit alu using behavioral approach.

Lab 10: Counter and seven segment display:

Write vhdl code for asynchronous binary up/down counter.

Write vhdl code for bcd up/down counter

Write vhdl code for seven segment display.

Siuli Roy

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Software Engineering & Project Management Laboratory					
Course Code: INFO3113					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

1. Ability to design the document according to functionality
2. Ability to learn the object oriented design.
3. Develop software applications in a development environment that makes use of commonly supported tools.
4. Develop and apply testing strategies for software applications;

Pre-requisite: For Software Engineering Lab, design a project proposal which will be used throughout the lab for performing different experiments using CASE Tools.

Detailed Syllabus:

1. Preparation of requirement document for proposed project in standard format.
2. Project Schedule preparation using tools like MSProject.Generation of Gnatt chart from schedule.Prepare Project Management Plan in standard format.
3. Draw DFD and ERD and prepare Functional Design Document using LibreOffice.
4. Draw Class diagram,Use Case Diagram,Sequence diagram ,Activity Diagram and prepare Object Oriented Design Document using tools like Dia.
5. Design Test Script/Test Plan(both Black box and WhiteBox approach) for a small component of the proposed project.
6. Generate Test Result and perform defect root cause analysis using Pareto or Fishbone diagram.

Following projects can be used as dummy projects:

- Library Management System
- Railway Reservation System
- Employee Payroll System
- Online Banking System
- Online Shopping Cart
- Online Examination System

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : DBMS Laboratory					
Course Code: INFO3114					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

1. Analyze. design and implement business problems as practiced in industry.
2. Familiarize with popular RDBMS software tools like Oracle.
3. Familiarize with administrative and security aspects of database.
4. Implement management principles / practices for handling projects under various business constraints.
5. To apply appropriate methodologies, techniques and software for designing and conducting experiments in order to analyze and interpret data using suitable data mining paradigms

Detailed Syllabus:

Structured Query Language

1.Introduction to server architecture

2.Creating database objects

- Creating a Table
- Specifying Relational Data Types
- Specifying Constraints
- Creating Column Aliases
- DROP, ALTER statements
- Creating an object structure from another existing structure

3. Table and Record Handling

- INSERT statement
- DELETE, UPDATE, TRUNCATE statements
- Populating data from other tables using insert and select together

4. Retrieving Data from a Database

The SELECT statement

- Using the WHERE clause
- Using Logical Operators in the WHERE clause
- Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING
- Clause
- Using Aggregate Functions
- Combining Tables Using JOINS
- Subqueries

5. Database Management

Creating Views

Creating Database Users

Granting and revoking Priviledges (GRANT, REVOKE)

Granting object priviledges

Basics of Programming Language/Structured Query Language (PL/SQL)

- Conditional /Iterative Statements
- Introduction to Functions and Stored procedures
- Exception Handling
- Cursor and its application
- Triggers

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Data Warehousing & Data Mining					
Course Code: INFO3201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) Discuss the role of data warehousing and enterprise intelligence in industry and government.

(2) Summaries the dominant data warehousing architectures and their support for quality attributes.

(3) Recognize and describe at least three computational approaches to data clustering, taking cognizance of the contribution of paradigms from the fields of Artificial Intelligence and Machine learning.

(4) Compare and contrast the dominant data mining algorithms.

(5) Construct a lightweight prototype or simulation that supports the concept of data mining.

(6) Analyze the results generated from the constructed artifact to determine if patterns of clusters were detected in the data sets.

(7) Demonstrate an appreciation of the importance of paradigms from the fields of Artificial Intelligence and Machine Learning to data mining.

Detailed Syllabus:

Module I [10]

Introduction: Data warehousing – definitions and characteristics, Multi-dimensional data model, Warehouse schema.

Data Marts: Data marts, types of data marts, loading a data mart, metadata, data model, maintenance, nature of data, software components; external data, reference data, performance issues, monitoring requirements and security in a data mart.

Online Analytical Processing: OLTP and OLAP systems, Data Modeling, LAP tools, State of the market, Arbor Essbase web, Microstrategy DSS web, Brio Technology, star schema for multi dimensional view, snowflake schema; OLAP tools.

Designing the Data Warehouse: Star Schemas, Dimensional Modeling, Metadata, Data Warehouse Design Examples.

Module II [8]

Data Mining: Definitions; KDD (Knowledge Discovery database) versus Data Mining; DBMS versus Data Mining, Data Mining Techniques; Issues and challenges; Applications of Data Warehousing & Data mining in industry.

Association Rules: A priori algorithm, Partition algorithm, Dynamic inset counting algorithm, FP – tree growth algorithm; Generalized association rule.

Module III [9]

Classification methods: Bayesian Classification, Neural Network, CBR, Genetic Algorithms.

Clustering Techniques: Clustering paradigm, Partition algorithms, K means, Fuzzy C menas CLARANS; Hierarchical clustering, DBSCAN; Categorical clustering, STIRR, ROCK.

Decision Trees: Tree construction principle, Best split, Splitting indices, Splitting criteria, Decision tree construction with presorting.

Module IV [9]

Web Mining: Web content Mining, Web structure Mining, Web usage Mining, Link Analysis Text Mining.

Big Data Handling: Introduction, Challenges, data storage (Hadoop), retrieval (Script languages) and computing for Big Data (Map reduces)

Dimensionality Reduction: PCA, Supervised Dimension Reduction.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

References:

1. Prabhu: Data Warehousing –Concepts, Techniques, products, application; PHI.
2. K. Pujari : Data Mining Techniques, Universities Press.
3. Alex Berson and Stephen J Smith: Data Warehousing, Data Mining and OLAP, TMH.
4. Anahory: Data Warehousing in the real world, Pearson Education.
5. Dunham: Data Mining Introductory & Advanced Topic, Pearson Education.
6. Foster Provost & Tom Fawcett: Data Science for Business: What you need to know about data mining and data-analytic thinking, O'Reilley.
7. Russell Jurney: Agile Data Science: Building Data Analytics Applications with Hadoop, O'Reilley.
8. Tom White: Hadoop: The Definitive Guide, O'Reilley.
9. Srinath Perera: Instant MapReduce Patterns - Hadoop Essentials How-to, Packt Publication

Course Name : Computer Network					
Course Code: INFO3202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>After successfully completing this course the students will be able to:</u>

(1) Analyze the pieces of hardware (hub, bridge, switch, router) to make networks more efficient, faster, more secure, easier to use, able to transmit several simultaneous messages, and able to interconnect with other networks.
(2) Specify and identify importance of existing protocols (DNS, DHCP, FTP, WWW, HTTP) are running in application layer.
(3) Compare the various techniques (open loop and close loop) are used for congestion control and quality of service (traffic scheduling and shaping).
(4) Analyzing why network needs flow control and error control and how subneting is used to divide the large network.
(5) Evaluate the performance of the different routing protocol (RIP, OSPF) based on routing cost, convergence rate and complexity to find the shortest path.

<u>Detailed Syllabus:</u>

Module – I [10L]
Introduction: Data communications, Direction of data flow - Simplex, Half-duplex, Full-duplex, Topology – Bus, Ring, Mesh. Star & Hybrid, Types of Network - LAN, MAN 7 WAN, Protocols, Reference models – OSI & TCP/IP reference model & comparative study.
Physical Layer: Transmission media - Guided & Unguided, Switching – Circuit, Packet & Message, Telephone Network, Network Devices: Repeaters, Hubs, Bridges, Switches, Router and Gateway.
Data link Layer: Types of Errors, Error Detection – Parity, CRC & Checksum, Error Correction – Hamming Code,

Module – II [10L]
Data link Layer: Flow Control – Stop-n-Wait & Sliding Window Protocol, ARQ Techniques – Stop-n-Wait, Go-Back- N & Selective Repeat, Framing, Bit & Byte Oriented Protocol, HDLC, Point to Point Protocol (PPP), Token Ring, FDDI and Ethernet Protocols, Reservation, Polling, Multiple access protocols - Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA

Module – III [10L]
Network Layer: Internet Protocol (IP), IPv4 vs IPv6, ARP & RARP, IP Addressing – Classful & Classless, Subnetting, VLSM, CIDR. Routing - Techniques, Static, Dynamic & Default Routing, Unicast Routing Protocols - RIP, OSPF, BGP.

Module – IV [10L]
Transport Layer: Process to Process delivery; UDP; TCP; Congestion Control - Open Loop, Closed Loop, Quality of service, Techniques to improve QoS - Leaky bucket & Token bucket algorithm.
Application Layer Protocols: DNS, SMTP, FTP & DHCP.

References:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Kurose and Rose – " Computer Networking -A top down approach featuring the internet" – Pearson Education
5. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Advanced Java & Web Technology					
Course Code: INFO3203					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>After successfully completing this course the students will be able to:</u>

1) Analyze and apply several kind of client side scripting (e.g : HTML, CSS and JavaScript).
2) Analyze and apply server side scripting using JSP..
3) Practice EJB, RMI and XML to implement J2EE at application level.

<u>Detailed Syllabus:</u>

Module-I: [8L]

*Static Web Pages:*Web Pages - types and issues, tiers; comparisons of Microsoft and java technologies, WWWBasic concepts, web client and web server, http protocol (frame format), universal resource locator (URL), HTML different tags, sections, image & pictures, listings, tables, frame, frameset, form.
*Dynamic Web Pages:*The need of dynamic web pages; an overview of DHTML, cascading style sheet (css), comparative studies of different technologies of dynamic page creation.
*Active Web Pages:*Need of active web pages; java applet life cycle, Java Swing.

Module-II: [7L]

*Java Script:*Data types, variables, operators, conditional statements, array object, date object, string object.
*Java Servlet:*Servlet environment and role, HTML support, Servlet API, The servlet life cycle, Cookies and Sessions.

Module-III: [12L]

*JSP:*JSP architecture, JSP servers, JSP tags, understanding the layout in JSP, Declaring variables, methods in JSP, inserting java expression in JSP, processing request from user and generating dynamic response for the user, inserting applets and java beans into JSP, using include and forward action, comparing JSP and CGI program, comparing JSP and ASP program; Creating ODBC data source name, introduction to JDBC, prepared statement and callable statement.

Module-IV: [13L]

*J2EE:*An overview of J2EE web services, basics of Enterprise Java Beans, EJB vs. Java Beans, basics of RMI, JNI.
XML: Extensible Markup Language (XML), basics of XML, elements and attributes, document type definition, XML parsers, sequential and tree approach.

References:

1. Web Technologies - Godbole A. S. & Kahate A., TMH.
2. Web Technology & Design - Xavier C., New Age Publication.
3. Java Server Programming, J2EE edition. (VOL I and VOL II); WROX publishers

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : E-Commerce & ERP					
Course Code: INFO3231					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) Convert an e-commerce based business model into a live e-commerce system.

(2) Choose right kind of hardware and software platforms for the e-commerce system they are building.

(3) Evaluate and justify the system by testing it from different aspects.

(4) Understand the importance of 'integration' of different systems within an organization

(5) Understand the basic concepts of ERP systems for manufacturing or service companies, and the differences among MRP, MRP II, and ERP systems

(6) Employ the thinking in ERP systems: the principles of ERP systems, their major components, and the relationships among these components

(7) Define the major ERP components, including material requirements planning, master production scheduling, and capacity requirements planning

(8) Realize the importance of project management in an ERP implementation project

(9) Understand what to expect, and not to expect, from a consultant implementing an ERP system

Detailed Syllabus:

Module 1:

Electronic Commerce: Overview, Definitions, Advantages & Disadvantages of E – Commerce, Drivers of E – Commerce, Myths, Dot Com Era,E-business.

Technologies :Relationship Between E – Commerce & Networking, Different Types of Networking For E – Commerce, Internet, Intranet & Extranet, EDI Systems, Wireless Application Protocol: Defn. Hand Held Devices, Mobility &Commerce, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement For E – Commerce .

Electronic Data Interchange (EDI): Meaning, Benefits, Concepts, Application, EDI Model, EDIFACT standard, Internet EDI

Module 2:

Business Models of e – commerce: Model Based On Transaction Type, Model B ased On Transaction Party - B2B, B2C, C2B, C2C, E – Governance, m-commerce.

E – strategy: Overview, Strategic Methods for developing E – commerce.

B2B E-commerce: Collaborative Commerce

Supply Chain Management: E – logistics, Supply Chain Portal, Supply Chain Planning Tools (SCP Tools), Supply Chain Execution (SCE), SCE - Framework, effect of different technologies on Supply Chain Mnagement.

Module 3:

E – Payment Mechanism: Payment through card system, E – Cheque, E – Cash, E – Payment Threats & Protections.

E – Marketing: Home –shopping, E-Marketing, Tele-marketing

Risk of E – Commerce: Overview, Security for E – Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures.

Module 4:

Enterprise Resource Planning (ERP): Features, capabilities and Overview of Commercial Software, re-engineering work processes for IT applications, Business Modules: Finance, Manufacturing (Production), Human Resources, Materials Management, QualityManagement, Sales&Distribution ERP Package,

ERP Market: ERP Market Place, SAP AG, PeopleSoft, BAAN, JD Edwards, Oracle Corporation

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

ERP-Present and Future: Enterprise Application Integration (EAI), ERP and E-Commerce, ERP and Internet, Future Directions in ERP

References:

1. E-Commerce-Strategy, Technologies & Applications by David Whitley, TMH
2. E-Commerce- The cutting edge of business by Kamlesh K. Bajaj, TMH
3. E-Commerce through ASP by W Clarke- BPB
4. Enterprise Resource Planning – A Managerial Perspective by D P Goyal, Tata McGraw Hill Education, 2011
5. Enterprise Resource Planning by Ashim Raj Singla, Cengage Learning, 2008

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Computer Graphics & Multimedia					
Course Code: INFO3232					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) Demonstrate activities and applications of device dependant and independent color models, image representation techniques (raster and random graphics), activities of active and passive graphics devices and computer graphics software.
(2) Compare effectiveness of DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm, Cohen and Sutherland line clipping, Sutherland-Hodgeman Polygon clipping, Cyrus-beck clipping method.
(3) Implement 2D and 3D transformation techniques (translation, rotation, scaling, shearing, reflection)
(4) Analyze and implement curve and surface representation techniques using Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves algorithms
(5) Describe hidden surface representation using Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods , fractal – geometry
(6) Demonstrate activities and applications of device dependant and independent color models, image representation techniques (raster and random graphics), activities of active and passive graphics devices and computer graphics software.
(7) Compare between image (.bmp, .jpg, .gif, .tiff), audio (.wav, .midi, .mp3), text (.txt, .doc, .pdf) and video (.mpeg, .wmv, .swf) formats according to their way of representing data, merits and demerits.
(8) Demonstrate image, video, text analysis tools and techniques.

Detailed Syllabus:

Module I (8 Lectures)
Introduction to computer graphics & graphics systems, Overview & use of computer graphics & Multimedia, Image, Image Processing, representing pictures, preparing, presenting & interacting with pictures for presentations, Visualization & image processing; Color Models, lookup table, Histogram; Image representing hardwares: Cathod Ray Tube, LCD & LED Display devices, Scanner, Digital Camera. Gamma, Interlacing, properties of display devices, different image formats.
Scan Conversion: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

Module II (10 Lectures)
2D transformation & viewing: Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines.
Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse. Cohen and Sutherland line clipping, Sutherland-Hodgeman Polygon clipping, Cyrus-beck clipping method
Overview of 3D Transformation and Viewing

Module III (8 Lectures)
Curves [3L]: Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.
Hidden surfaces [3L]: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods , fractal -

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

geometry.
Color & shading models [2L]: Light & color model; interpolative shading model; Texture.

Module IV (10 Lectures)
Text: Different types of text representation, Hypertext, text representation formats.
Audio: Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI
Video: Analogue and Digital Video, Recording Formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals, Video Capture
Animation: Techniques of 2D & 3D animation, formats of Animation
Image and Video Database:Image representation, segmentation, similarity based retrieval, image retrieval by color, shape and texture; indexing- k-d trees, R-trees, quad trees; Case studies- QBIC, Virage. Video Content, querying, video segmentation, indexing.

References:

1) Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson education
2) Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
3) D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH
4) Ralf Steinmetz and Klara Nahrstedt , Multimedia: Computing, Communications & Applications , Pearson Ed.
5) Fred Halsall , Multimedia Communications , Pearson Ed.
6) Ralf Steinmetz and Klara Nahrstedt , Multimedia Fundamentals: Vol. 1- Media Coding and Content Processing , PHI.
7) Ranjan Parekh, "Principles of Multimedia", TMH

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : System Software and Administration					
Course Code: INFO3233					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) To understand the basics of system programs like editors, compiler, assembler, linker, loader, interpreter, debugger how linker and loader create an executable program from an object module created by assembler and compiler.

(2) To understand the various phases of compiler and compare its working with assembler.

(3) Use multiple computer system platforms, and understand the advantages of each.

(4) Protect and secure users' information on computer systems.

(5) Install and manage disks and file systems.

Detailed Syllabus:

Module – I [10L]

System Software:

Assemblers - General design procedures, Design of two pass assemblers, Cross Assemblers, Macro Processors – Features of a macro facility, (macro instruction arguments, conditional macro expansion, macro calls within macros), Implementation of a restricted facility - A two pass algorithm; Macro Assemblers.

Loader schemes - Compile and go loaders, absolute loaders, relocating loader, Linking, Reallocation – static & dynamic linking, Direct linking loaders, Binders, Overlays, dynamic binders; Working principle of Editors, Debuggers.

Module - II [10]

System Administration - Duties of the Administrator, Administration tools, Overview of permissions.

Processes - Process status, Killing processes, process priority.

Starting up and Shut down - Peripherals, Kernel loading, Console, The scheduler, init and inittab file, Run-levels, Run level scripts.

Managing User Accounts - Principles, password file, Password security, Shadow file, Groups and the group file, Shells, restricted shells, user management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users.

Managing Unix File Systems - Partitions, Swap space, Device files, Raw and Block files, Formatting disks, Making filesystems, Superblock, I-nodes, Filesystem checker, Mounting filesystems, Logical Volumes, Network Filesystems, Boot disks

Module – III [10]

Configuring the TCP/IP Networking - Kernel Configuration; Mounting the /proc Filesystem, Installing the Binaries, Setting the Hostname, Assigning IP Addresses, Creating Subnets, Writing hosts and networks Files, Interface Configuration for IP, ifconfig, netstat command, Checking the ARP Tables; Name service and resolver configuration.

TCP/IP Firewall - Methods of Attack, Firewall, IP Filtering, A Sample Firewall Configuration using iptables.

Module IV [10]

IP Accounting - Configuring the Kernel for IP Accounting, Configuring IP Accounting, Using IP Accounting Results IP Masquerade and Network Address Translation, Configuring the Kernel for IP Masquerade, Configuring IP Masquerade.

The Network Information System - Getting Acquainted with NIS, NIS Versus NIS+ , The Client Side of NIS, Running an NIS Server, NIS Server Security.

Network file system - Preparing NFS, Mounting an NFS Volume, The NFS Daemons, The exports File.

System Backup & Recovery - Log files for system and applications; Backup schedules and methods (manual and automated).

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

References:

1. L.L. Beck – “System Software “ (3 rd Ed.)- Pearson Education
2. Michel Ticher – “PC System Programming” , Abacus.
3. Kirch – “ Linux network Administrator’s guide (2 nd Ed.)” – O’Rielly
4. Maxwell – “Unix system administration” – TMH
5. Limoncelli –“The Practice of System & Network Administration”-Pearson

Course Name : Artificial Intelligence					
Course Code: INFO3241					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) Define the different problems of AI , different search techniques, Heuristic search strategies, Adversarial search technique etc.

(2) Analyze the behavior of intelligent agents, the nature of environment, and the structure of agents and then differentiate among different intelligent agents: goal based agents, utility based agents, learning agents.

(3) Solving problems by Searching: problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search etc.

(4) Compare among different Heuristic search strategies: Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, constraint satisfaction problems.

(5) Differentiate between Heuristic search strategies and Adversarial Search strategies.

(6) Construct different planning technique: Goal stack planning, Hierarchical planning, other planning technique

(7) Discuss different Forms of learning: inductive learning, Learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning

Detailed Syllabus:

Module-I: [10L]
Introduction:
Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents: Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. Problem Solving: Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

Module-II: [10L]
Search techniques: Solving problems by searching: problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies: Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, constraint satisfaction problems, local search for constraint satisfaction problems. Adversarial search: Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning.

Module-III: [10L]
Knowledge & reasoning: Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation. Using predicate logic: Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules:
Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge. Probabilistic reasoning: Representing knowledge in an uncertain domain, Fuzzy sets & fuzzy logics.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Module-IV: [10L]

Planning: Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques. Expert Systems: Representing and using domain knowledge, expert system shells, knowledge acquisition. Basic knowledge of programming language like Prolog & Lisp.

References:

1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Poole, Computational Intelligence, OUP
5. Logic & Prolog Programming, Saroj Kaushik, New Age International
6. Expert Systems, Giarranto, VIKAS

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Wireless & Mobile Computing					
Course Code: INFO3242					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

1. Identify the basic concept of wireless networks;
2. Analyse traffic theories, mobile radio propagation, channel coding, and cellular concepts;
3.Compare and contrast multiple division techniques, mobile communication systems, and existing wireless networks;
4. Classify network protocols, ad hoc and sensor networks, wireless MANs, LANs and PANs.

Detailed Syllabus:

Module-I: [8L]
Fundamentals of wireless communication and computer networking: Electromagnetic spectrum; Characteristics of wireless channel; Modulation techniques; Multiple access techniques; Voice coding; Computer network architectures (reference models)

Module-II: [14L]
Fundamentals of wireless LANs, PANs, WANs, MANs and Wireless Internet: IEEE 802.11, HIPERLAN standards; Bluetooth; HomeRF; Cellular concept and architecture; First, second, and third generation cellular networks; Wireless in local loop systems, standards, and future trends; Mobile IP; TCP over wireless; Wireless application protocol; Optimizing Web over wireless.

Module-III: [8L]
Ad hoc wireless networks: Issues and challenges in infrastructure-less networks; MAC protocols; Routing protocols; Multicast routing protocols; Transport and security protocols; Quality of service provisioning; Energy management.

Module-IV: [10L]
Hybrid wireless networks and wireless sensor networks: Architectures and routing protocols for hybrid wireless networks; Load balancing schemes; Pricing schemes for multi-hop wireless networks; Issues and challenges in wireless sensor networks: Architectures and routing protocols; MAC protocols; Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.
Recent advances in wireless networks: Wide Band (UWB) communication; Issues and challenges in UWB communication; Applications of UWB communication; Wireless Fidelity (Wi-Fi) systems; Issues in Wi-Fi Systems.

References:

1. Kaveh Pahlavan, Prashant Krishnamoorthy, Principles of Wireless Networks, - A united approach – Pearson Education.
2. Jochen Schiller, Mobile Communications, Person Education.
3. Wang and H.V.Poor, Wireless Communication Systems, Pearson education.
4. M.Mallick, Mobile and Wireless design essentials, Wiley Publishing Inc.
5. P.Nicopolitidis, M.S.Obaidat, G.I. papadimitria, A.S. Pomportsis, Wireless Networks, John Wiley & Sons.
6. T. S. Rappaport, "Wireless Communications: Principles & Practice," Prentice-Hall.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

7. Feng Zhao, Leonidas Guibas ,"Wireless Sensor Networks :An Information Processing Approach",Elsivier.
8. C. Siva Ram Murthy, B.S. Manoj ," Ad Hoc Wireless Networks: Architectures and Protocols", Pearson Education

Course Name : Pattern Recognition					
Course Code: INFO3243					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

(1) Analyze classification problem probabilistically and estimate classifiers (bayesian, kNN, ANN, K-means) performance.

(2) Design and compare the machine learning models (nearest-neighbor rule, linear discriminant functions, NN and SVM) and which model is appropriate for a problem or why it is not appropriate.

(3) Analyze the performance of different clustering algorithm (k-means, Fuzzy C means and EM) on big data set based on isclassification rate.

Detailed Syllabus:

Module – I [10L]

Introduction: Basics of pattern recognition, Design principles of pattern recognition system, Metric and Non-Metric Proximity Measures: Distance between Pattern Collections.

Bayes Decision Theorem: Bayes Classifier, Linear and non-linear Discrimination functions, Minimum error rate classification, Error probability.

Module – II [10L]

Parameter Estimation: Maximum-Likelihood estimation, Gaussian mixture models, Expectation-maximization method, Bayesian estimation, Hidden Markov model

Nonparametric Techniques: Parzen-window method, Nearest Neighbor method

Module – III [10L]

Nonlinear Classifier: Learning - Supervised and Unsupervised, Perceptron, Decision Tree.

Clustering: Process, Algorithms (basic hierarchical, Agglomerative, Partitional, K-means and Fuzzy C-means)

Module – IV [10L]

Feature selection: class Separability Measures – Divergence, Chernoff Bound & Bhattacharyya Distance, Scatter Matrices, Dimensionality reduction, similarity measures, feature selection criteria and algorithms, principal component analysis.

References:

1. R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification, 2nd ed., Wiley.
2. J. T. Tou and R. C. Gonzalez: Pattern Recognition Principles, Addison-Wesley, London.
3. Christopher M. Bishop, Neural Networks for Pattern Recognition, Oxford University Press.
4. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer.

Siuli Roy

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Data Analysis Laboratory					
Course Code: INFO3211					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>After successfully completing this course the students will be able to:</u>

(1) Demonstrate the importance of preprocessing the given datasets.

(2) Design and implement classification algorithm to classify given problems using modern tools.

(3) Design and implement clustering algorithm to group the given attributes in a datasetusing modern tools.

(4) Demonstrate to find association rules for the given datasetsusing modern tools.

(5) Develop skills to design data warehouse for an enterprise.

<u>Detailed Syllabus:</u>

Introduction:

Setting up R and/or python with NumPy, mlpy/mdp.

Assignment 1:

Based on Data Acquisition, Cleaning and feature extraction. Obtain a dataset which has features in text instead of numbers. Generate a csv from it which contains only numeric fields.

Assignment 2:

K-Means on a dataset: Observe the effects on variation of the number of centroids and different centroid selection algorithms.

Assignment 3:

Creating a perceptron and learning until stability; learn different other models of pf ANN

Assignment 4+5:

Using libSVM dataset: Compare libsvm values (obtained using libsvm's exe distributed free on the site) against your own SVM. (In the industry, DA is used mainly to generate reports. Hence it is very essential to understand how comparative charts are created and read)

Assignment 6:

Hadoop Set-up for big data.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Computer Network Laboratory					
Course Code: INFO3212					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

(1) Develop the C programs to send the message among the computers using datagram and internet socket.

(2) Compare the time complexity of the stop-n-wait, go-back-N and selective repeat ARQ.

Detailed Syllabus:

1. NIC Installation & Configuration
2. TCP/UDP Socket Programming – Introduction
3. Sockets – Operation, Socket types, Domains, Closing Sockets
4. Client/Server Models - Usage
5. Connection Based Services - Client and Server actions
6. Connectionless Services - Client and Server actions
7. Access Network Database - Host Information, Network Information, Protocol Information

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Advanced Java & Web Technology Laboratory					
Course Code: INFO3213					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

1) Experiment and analyze several kind of client side scripting (e.g : HTML,XML, and JavaScript) and server side scripting (e.g : Servlet and JSP) languages.

2) Practice and apply EJB, RMI and XML to implement J2EE application.

Detailed Syllabus:

1. HTML
2. CSS [Inline, External]
3. JavaScript Control Structure JavaScript Events and Functions
4. JavaScript Validation and implementation in HTML Form
5. Servlet
6. JSP
7. JDBC for Database Connectivity using JSP
8. Java Applet and its implementation through JSP
9. Java Bean Creation
10. Basic Concepts of EJB and RMI and its implementation by creating Bean
11. XML Document Creation, DTD, Schema

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : E-Commerce & ERP Laboratory					
Course Code: INFO3236					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

(1) Create web pages using HTML, DHTML and Cascading Styles sheets.
(2) Create dynamic web pages using JavaScript and VBScript.
(3) Create interactive web applications using ASP.NET.
(4) Build web applications using PHP.
(5) Integrate standard database applications like Oracle, SQL Server to a web site.
(6) Convert an e-commerce based business model into a live e-commerce system.
(7) Choose right kind of hardware and software platforms for the e-commerce system they are building.
(8) Evaluate and justify the system by testing it from different aspects.

Detailed Syllabus:

1. Following E-Commerce experiments are to be implemented using either VB, ASP, SQL or JAVA, JSP, SQL.

2. Creating E-Commerce Site: Designing and maintaining WebPages. Advertising in the Website, Portals.

3. E-Commerce Interaction : Comparison Shopping in B2C, Exchanges Handling in B2B, Interaction Examples: Virtual Shopping Carts.

4. E-Commerce Applications : Online Store, OnlineBanking, Credit Card Transaction Processing

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : Computer Graphics & Multimedia Laboratory					
Course Code: INFO3237					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>After successfully completing this course the students will be able to:</u>

(1) Apply the concept of Scan conversion algorithms to draw geometrical without help of graphics.h
(2) Compare efficiency of different computer graphics algorithms.
(3) Apply and Combine different Adobe Photoshop tools to edit images.
(4) Design Animation videos using Adobe Flash software.
(5) Develop web pages using HTML, DHTML and Java Script

<u>Detailed Syllabus:</u>

1) Implementation of line drawing algorithms
2) Implementation of circle & ellipse drawing algorithms
3) Implementation of area filling algorithms
4) Implementation of 2D transformation algorithms
5) Implementation of line clipping algorithms
6) Familiarization of image editing softwares and performing image editing using them
7) Familiarization of animation softwares and creating 2D animations using them
8) Web page design using HTML
9) Use of CSS and Java Script in Web designing

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : System Software and Administration Laboratory					
Course Code: INFO3238					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

After successfully completing this course the students will be able to:

(1) To understand and configure different servers in linux system.
(2) Use multiple computer system platforms, and understand the advantages of each.
(3) configure firewall to Protect and secure users' information on computer systems.
(4) Install and manage disks and file systems.

Detailed Syllabus:

1. Packet Monitoring software - tcpdump, snort, ethereal, Trace route, Ping, Finger, Nmap
2. Server configuration - FTP, DHCP, NFS, NIS, SMTP, DNS, SAMBA
3. IP Accounting
4. Firewalls, Security and Privacy - iptables
5. System Startup and Operation
6. Disk Partitioning and Filesystem Installation
7. Filesystem and Device Manipulation
8. Process and Log Analysis
9. Startup Scripts and Configuration Files
10. User/Group Security and Permissions
11. Backup
12. Scheduling Maintenance Functions
13. Implement assembly language instructions using C.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Subject Name: Chemical Reaction Engineering					
Paper Code: CHEN 3102					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

1. Ability to apply the basic knowledge that allows the students to solve chemical reaction engineering problems through logic.
2. Ability to utilize experimental data for predicting rate equation and to use this information in designing homogeneous single and combination of multiple reactors for specified conditions.
3. Ability to use principles of chemical reaction engineering for selecting and designing suitable contacting device for multiple reactions system. .
4. Ability to solve problems of mass transfer with reaction in solid catalyzed reactions.
5. Ability to differentiate between ideal and non ideal reactors using suitable model equations and to utilize the design strategies of non ideal reactors.
6. Ability to apply the concepts of RTD as a tool for designing and scale up industrial reactors.

Module I [10L]

Introduction; Definition of reaction rate; Kinetics of homogeneous reaction: Concentration- dependent term of a rate equation, single and multiple reactions, rate equation from given mechanisms.

Elementary & Nonelementary reactions, Molecularity and order of reaction, Representation of reaction rate, Kinetics for non elementary reactions, related problems, Temperature dependent term of a rate equation: Arrhenius law, Collision theory, Transition-state Theory, related problems.

Interpretation of batch reactor data: Constant-volume batch reactor, Integral method of analysis of data: General Procedure, Irreversible unimolecular-type first-order reaction, Irreversible bimolecular-type second-order reactions, rate equation for enzymatic reaction, Zero-order reactions, Over-all order of irreversible reactions from the Half-life method, Initial rate method of analysis.

Irreversible Reactions in parallel, Autocatalytic reactions, Irreversible reactions in series, First- order Reversible Reactions, Differential method of Analysis of data: Analysis of the Complete Rate Equation, Partial analysis of rate equation,

Variable-Volume reaction system: Its Integral method of analysis for Zero-order reactions, First order reaction, Second-order reactions;

Module II [10L]

Single ideal Reactors: Introduction; Basic division of ideal reactors, Ideal Batch Reactor, Concept of flow reactors, Space-time and Space-velocity,

Steady-state Mixed Flow Reactor: Design Equation, Graphical Representation of Design Equation, related problem;

Steady-state Plug Flow Reactor: Design equation, graphical representation, related problem;Design for Single Reactions: Size and comparison of single reactors: Batch Reactor, PFR, MFR, General Graphical Comparison;

Multiple-Reactor Systems: PFRs in Series and/or in Parallel, Equal-size MFRs in Series, MFRs of different sizes in Series, Determining the best size combination of reactor size for a given combination, Reactors of Different Types in Series, Recycle Reactor: Definition of Recycle Ratio, Design Equation, and Optimum Recycle ratio.

Module III [10L]

Design for Multiple Reactions: Introduction, Reactions in Parallel, Qualitative aspects of Product Distribution, Quantitative Treatment of Product Distribution and of Reactor Size: Definition of Instantaneous and Overall fractional yield, graphical representation; Reactions in Series: Successive First- Order Reactions, Product Distribution, Quantitative Treatment of PFR, MFR and Batch Reactor.

Solid-Catalyzed Reaction: Introduction; Basic idea of catalysis, Catalyst properties, Steps in catalytic reaction: Qualitative discussion on Pore Diffusion, Adsorption, Surface reaction and Desorption, Concept of Rate limiting step;

Design of reactors for gas-solid reactions: Design equation and data analysis of heterogeneous system; Quantitative aspects of Pore diffusion controlled reactions (single cylindrical pore, first- order reaction): Material balance for the elementary slice of catalyst pore, Definition of Thiele Modulus and Effectiveness Factor.

Different methods of catalyst preparation. Catalyst surface area and pore volume measurement

Fluid-Particle Reactions: Introduction; Different behavior of reacting solid particles; Selection of a Model; Qualitative discussion on Progressive Conversion Model & Unreacted Core Model;

Introduction to non isothermal reactions: adiabatic and temperature programmed reactions.

Module IV [10L]

Distribution of Residence Times for Chemical Reactors: General Characteristics; Residence- Time Distribution (RTD) Function;

Measurement of the RTD: Pulse Input; Related problems; Characteristics of RTD: Integral Relationships, Mean Residence Time, Different Moments of RTD; RTD in Ideal Reactor: RTD in Batch and PFR, Single CSTR, PFR/CSTR series RTD; Concept of Macromixing & Micromixing, Zero Parameter Model: Segregation Model & Maximum Mixedness Model.

Models for Nonideal Reactors: Introduction; One-Parameter Models: Tanks in Series Model, Dispersion Model: Basic Formulation, Definition of Peclet Number & Vessel Dispersion Coefficient, Boundary Conditions (Closed-Closed & Open-Open), Correction for Sloppy Tracer Input, Relation between Flow, Reaction and Dispersion.

Text Books :

1. Elements of Chemical Reaction Engineering, 4th. Edition, H. Scott Fogler, Prentice Hall.
2. Chemical Reaction Engineering, 2nd. & 3rd. editions, O Levenspiel.: Wiley Eastern Ltd.

Books of reference :

1. Chemical Reactor Analysis and Design Fundamentals, J. B. Rawlings and J. G. Ekerdt. Nob Hill Publishing.
2. Chemical Engineering Kinetics, 3rd. Edition, J.M. Smith, MGH.

3. Chemical Engineering Kinetics and Reactor Design, C.G. Hill, Wiley.
4. The Engineering of Chemical Reactions, 2nd. Edition, L. D. Schmidt, Oxford.
5. Experiments in Catalytic Reaction Engineering, J. N. Berty, Elsevier.

Subject Name: Separation Process – II

Paper Code: CHEN 3103

Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcome:

1. Students will be able to illustrate the characteristics of saturated and unsaturated vapor-gas mixtures, dry and wet-bulb thermometry and to design humidifier.
2. Students will be able to classify different types of cooling towers and will be able to design height of cooling tower.
3. Students will be able to illustrate selectivity, choice of solvent during extraction and leaching and will be able to determine number of equilibrium stages by graphical method.
4. Students will be able to describe the concept of crystallisation along with the mathematical formulation of the process.
5. Students will be able to describe the concept of drying and its relation with humidification process.
6. Students will be able to classify different membrane separation and will be able to evaluate the merits of the process.

Module I : 10L

Humidification & Dehumidification Processes:

Introduction to Humidification and dehumidification operations, Characteristics of saturated and unsaturated vapor gas mixtures, Dry and wet bulb thermometry, Psychrometric chart, Adiabatic saturation curves, Psychrometric ratio, Gas liquid contact, Design of humidifiers, Dehumidification operation, Principle and design of cooling towers -Natural draft, forced draft and induced draft cooling towers.

MODULE II : 10L

Liquid-Liquid Extraction & Leaching:

Introduction to Extraction, Liquid- liquid equilibria, Triangular diagram, Selectivity and choice of solvents, Stage-wise contact, Co- current & counter-current extractor, Stage type extractors and differential extractors, Determination of number of equilibrium stages by graphical method for multistage extraction, Supercritical Fluid Extraction.

Introduction to leaching, General principle, Factors affecting the rate of extraction, Calculation of number of stages, Batch processes, Counter-current washing, Stage calculation methods.

MODULE III :10L

Drying & Crystallization**:**

Introduction to drying, Rate of drying, Batch drying mechanism, Time of drying, the mechanism of moisture movement during drying, Classification and selection of dryer, Batch dryer and continuous dryer.

Introduction to crystallization, Theory of Crystallization, Formation and growth of crystals, Crystal yield, Rate of crystallization, Crystallizers.

MODULE IV: 10L

Membrane Separation Processes:

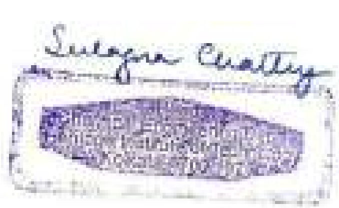
Introduction to membrane separation processes, Classification of membranes and membrane processes, Dialysis, Ultra filtration- Concentration Polarization, Application of Ultrafiltration Process, Reverse Osmosis, Reverse osmosis in water treatment plant, Pervaporation, Electrodialysis, Membrane fouling, Liquid membrane.

Text Books:

1. Mass Transfer Operations: Robert E. Treybal, McGraw Hill, International StudentEdition, 1981.
2. Principles of Mass Transfer and Separation Processes, Binay K. Dutta, Prentice Hall of India, 2007.
3. Transport Process and Unit Operations: Christie J. Geankoplis. 3rd Edition., 1993, Prentice Hall of India.

References:

1. Separation Processes: King, C. J., McGraw Hill, Chemical Engineering Series.
2. Separation Process Principles, 3rd Edition, J.D. Seader, Earnest J. Henley, D. KeithRoper, 2010.
3. Unit Operations in Chemical Engineering: Mc Cabe and Smith, Harriot., McGraw Hill, Seventh Edition.
4. 4.Coulson and Richardson's Chemical Engineering, Volume 2, Fifth Edition, J. F.
5. Richardson and J.H. Harker with J.R. Backhurst, Pergamon Press.
6. Perry's Chemical Engineers' Handbook, , 8th Edition, McGraw Hill.



Subject Name: Numerical Methods of Analysis					
Paper Code: CHEN 3104					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcome:

After completion of the course the students will be able to

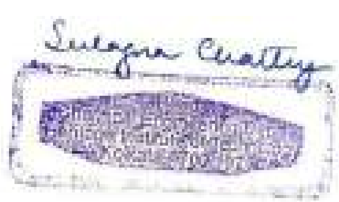
1. Given a mathematical problem to be solved numerically, students should be able to identifydifferent computational errors and evaluate them. Students should know how to perform numerical interpolation, numerical integration and find relative and absolute error in each case.
2. Given an engineering problem that can be mathematically modeled using linear algebra, students will be able to relate the dependent and independent variables to define the final equation. Students will be able to identify the broad category of numerical method to solvethe corresponding mathematical problem.
3. Given an non-linear engineering problem requiring single or simultaneous equation, studentsshould also be able to select the appropriate numerical algorithm to solve for roots of the equation. In case the algorithm does not converge, students should identify the source of problem and be able to solve for converged values.
4. Given an engineering problem that can be modeled through ordinary differential equation,students will be able to select appropriate numerical algorithm (e.g Euler or Runge Kutta method etc.) to determine the dynamic or spatial changes in the dependent variables undergiven initial/boundary conditions.
5. Given an engineering problem that can be modeled using partial differential equations (PDE),students will be able to identify the type of PDE and its associated boundary conditions. Students should develop the numerical form of the governing equation by applying principlesof numerical differentiation.
6. Given a problem as in 5, students will be able to predict values of dependent variable (e.g.Temperature as a function of time and position as in the case of heat conduction in a linearrod) for various types of initial and boundary conditions.

Module I: **10L**

Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors.

Interpolation: Newton forward/backward interpolation, Lagrange’s and Newton’s divided difference Interpolation.

Numerical integration: Trapezoidal rule, Simpson’s 1/3 rule, Expression for corresponding errorterms.



Module II: **10L**

Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion,LU Factorization method, Gauss-Seidel iterative method.

Bisection method, Secant method, Newton-Raphson method.

Module III: **10L**

Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods,Predictor-Corrector methods.

Module IV: **10L**

Numerical Differentiation – Forward and Backward difference algorithms, First and Secondorder derivatives. Finite Difference methods for Boundary Value Problems, Parabolic PDEs.

Textbook:

1. Numerical Methods for Engineers – R. Chapra and S. Canale, Sixth Edition 6thEdition, McGraw-Hill Science/Engineering/Math, 2009.

Reference:

1. Mathematical Methods in Chemical Engineering – V.G. Jenson and G.V. Jeffreys,Academic Press, 2nd Edition.

Subject Name: PEDD- I					
Paper Code: CHEN 3112					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**3**

Course Outcome:

After completion of the course students will be able to

1. understand the concepts of pressure vessel and reactor along with their applicability.
2. understand of process equipment accessories and support systems.
3. design pressure vessel and reactor along with the cooling coil arrangement.
4. design horizontal pressure vessel with saddle support and various parts of vessels (e.g. heads, nozzels etc.).
5. design vertical reactor with lug support, spiral cooling coil, gasket and various parts of vessels (e.g.heads, nozzels etc.).
6. understand the procedure with proper scale to draw the aforesaid equipments using AUTOCAD.

Designs to be performed:

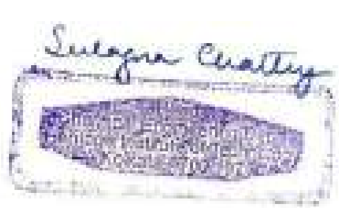
1. Design and Drawing Pressure Vessel - thin and thick cylinder design, design of cylinder head, cover plate, selection of gasket, design of bolt and flange.

2. Design and Drawing of Reactor.

Each student shall be allotted design problems on sl. no 1& 2 at the beginning of the 5th semester and the student shall carryout complete process and mechanical design under supervision of a faculty. The student shall also prepare engineering drawing of the equipmentand submit two copies of the design report in tight and bound form 7 days before commencementof 5th semester examination. Assessment would be made on the basis of the submitted report andthe viva voce examination conducted by a board of examiners constituted by the Departmental Academic Committee consisting of two faculty members and class teachers with Head of the Department as Chairman during 5th. Semester examination.

Text Book / References:

1. Process Equipment Design – Brownell and Young, John Wiley and sons.
2. Chemical Engineering Design, Fourth Edition: Chemical Engineering Volume 6 (Coulson & Richardson's Chemical Engineering) 4th Edition - by R K Sinnott (Author), Butterworth-Heinemann; 4 edition.



Subject Name: Chemical Reaction Engineering Laboratory					
Paper Code: CHEN 3113					
Contact Hours	**L**	**T**	**P**	**Total**	**Credit Points**
Per Week	**0**	**0**	**3**	**3**	**2**

Course Outcomes:

1. Students will be able to draw concentration vs. time curve and determine the rate constant for a homogeneous liquid phase reaction in a batch reactor.
2. Students will be able to determine the rate constant for a homogeneous liquid phase reaction in a semi-batch reactor.
3. Students will be able to determine the rate constant, reaction rate, conversion and residence time for a non-catalytic homogeneous reaction in an isothermal CSTR.
4. Students will be able to determine the rate constant, residence time and conversion for a non-catalytic homogeneous reaction in an isothermal PFR (coiled type).
5. Students will be able to determine the rate constant, residence time and conversion for a non-catalytic homogeneous reaction in a packed bed reactor (coiled type).
6. Students will be able to determine the rate constant and equilibrium adsorption constant for a heterogeneous catalytic reaction in an U.V. photoreactor.
7. For a non-catalytic liquid phase reaction in a coiled PFR, students will be able to plot the concentration vs. time curve, exit age distribution curve and will be able to determine the mean residence time and axial dispersion coefficient for pulse input of tracer.

(At least eight experiments are to be performed)

Experiments:

1. Experimental studies on kinetics of a non catalytic homogeneous liquid phase reaction in an isothermal batch reactor.
2. Experimental studies on kinetics of a homogeneous liquid phase reaction in an isothermal semi batch reactor.
3. Experimental studies on kinetics of a non catalytic homogeneous liquid phase reaction in a Spiral plug flow reactor.
4. Experimental studies on kinetics of a non catalytic homogeneous liquid phase reaction in an isothermal CSTR.
5. Experimental studies on kinetics of a non catalytic homogeneous liquid phase reaction in a packed bed reactor.
6. Experimental studies on RTD in a tubular PFR using pulse input of tracer and measurement of axial dispersion coefficient.
7. Experimental studies on kinetics of a heterogeneous catalytic reaction in a UV photoreactor.
8. Experimental studies on RTD in a packed bed reactor using pulse input of tracer and measurement of axial dispersion coefficient.
9. Experimental studies on kinetics of hydrolysis of ethyl acetate in presence of acid catalyst in an adiabatic batch reactor.

10. Experimental studies on kinetics of sulfonation of toluene in an isothermal batch reactor.

Subject Name: Polymer Science & Engineering					
Paper Code: CHEN 3131					
Contact	**L**	**T**	**P**	**Total**	**Credit Points**
Hours PerWeek	**3**	**0**	**0**	**3**	**3**

Course Outcome:

1. The students will learn the principles of polymerisation and will be prepare organic polymeric materials in the laboratory and characterise the structure nad composition ofthe polymers.
2. The students will be able to identify and control the mechanism of polymerisation processes and properties of versatile polymeric materials in the industry and R&D activities.
3. The students will learn and apply the understanding of polymer processing techniques like Injection Molding, Blow molding, compression molding, extrusion molding etc and follow the process to make polymer articles in the industry.
4. The students will be exposed to the knowledge of developing biodegradable and bio-compatible polymers for maintaing ecology of the soil.
5. The students will learn various types of polymer composites to develop new materials.
6. The students will be knowledgeable in identifying and controlling the use of hazardous behaviour of plastics in the industrial applications and social applications, particularly heath issues.

Module I: 10 L

Definitions and concepts of terms used in polymer engineering, Classification of polymers; Polymer structures, functionality; polymerization reactions – mechanism of polymerization; stereospecific polymerization, copolymerization.

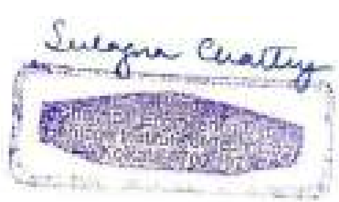
Introduction to nano-polymers: Characterisation techniques: XRD, FESEM and AFM

Module II: 10 L

Polymerization reactors, polymerization processes, characterization of polymers: DSC, DTGA, DMA, Creep Test analysis of polymerization reactions, polymer degradation.

Module III: 10 L

Molecular weight and molecular weight distribution in polymers, properties of polymers –physical, chemical, mechanical and electrical properties of polymers, elementary idea on polymer rheology, polymer blends.



Module IV: 10 L

Polymer processing: modeling – compression & transfer, injection & jet; casting; extrusion,calendaring, lamination, spinning & finishing.

Text Books:

1. Text Book of Polymer Science, 2nd Ed., F. W. Billmeyer, Jr., Wiley–Interscience, New York, 1971.
2. Polymer Science & Technology, P. Ghosh, Publisher: McGraw Hill Education (India) Private Limited; edition (26 November 2010)

References:

1. The elements of Polymer Science & Engineering, Alfred Rudin, Academic Press, 2nd Edition, 1999
2. Introduction to Polymers, 2nd edition, by (second edition) R. J. Young and P. A. Lovell Chapman and Hall, London, 1991.

Subject Name: Petrochemical Technology					
Paper Code: CHEN 3132					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	0	0	3	3

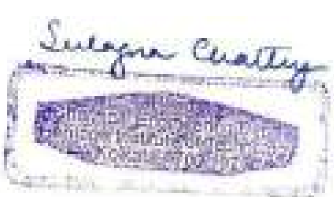
Course Outcome:
1. Students will understand the variety of petrochemical feedstocks and products
2. Students will understand the role of petroleum as energy source amidst world energy scenario.
3. Students will learn the design and operation of petrochemical complexes.
4. Students will familiar with major polymerization processes on industrial scale.
5. Students will gather the knowledge of various process technologies for Fibers, Elastomers and resins.
6. Students will motivate themselves towards innovations

Module I : 10L
Evolution of petrochemical industry in India, recent trend of petrochemical industry in India, Petrochemical industry feedstock: overview of petroleum refinery industry and its product, natural gas processing; impurities in feedstock for petrochemical industry and the process of their removal.
Synthesis gas production and its use: Steam reforming operation of Naphtha and natural gas, fuel oil partial oxidation method, Methanol production, synthetic liquid fuel production by Fischer- Tropsch process, aldehyde and alcohol production from synthesis gas, ammonia production and its application.

Module II : 10L
Steam cracking operation of naphtha and C2 to C4 saturates, downstream separation scheme of naphtha cracking. Manufacture of Petrochemicals based on Ethylene: EDC, VCM, VAM, Ethylene oxide, Ethanol amine Manufacture of Petrochemicals based on Propylene: Acrylonitrile, Acrolein, Propylene oxide, glycerine (acrolein route, allyl chloride route, propylene oxide route), Isopropanol Production of Butadiene from C4 cut.

Module III : 10L
Catalytic reforming of naphtha, catalyst and process variable of BTX reformer, separation of Benzene, Toluene and Xylene from BTX reformate, pyrolysis gasoline hydrogenation and separation of aromatics, separation of meta xylene from mixed xylenes, alkylation of benzene, production of styrene, cumene and phenol, production of Phthalic anhydride. Synthetic detergent and its classication, production of linear alkyl beanzene and keryl benzene sulfonate from kerosene cut, additives for detergent.

Module IV : 10L
Overview of plastic industry: Production of LDPE, LLDPE, HDPE, PP, PVC, Polystyrene and their application. Comparative study of Plastic, fibre and elastomer; production of SBR, Butadiene rubber, production of ABS plastic, polyamide, polyester, acrylic fibre, polycarbonates, production of phenol-formaldehyde resin; overview of polymer processing.



Text Books:
1. A Text on Petrochemicals: B.K.B. Rao, Khanna Publishers, 2011, ISBN 9788174090447 / 8174090444
2. Advanced Petrochemicals: Dr. G. N. Sarkar, Khanna Publishers, 2008, ISBN 8174090967
3. Introduction to Petrochemicals, Sukumar Maity. Oxford and IBH Publishing Co, 2002
ISBN 8120415558

References:
1. The Petroleum chemicals Industry: R. F. Goldstein and A. L. Waddams, E & F N
Spon (An imprint of Routledge), 1967, ISBN 0419025308.
2. Petrochemical processes: Chauvel , Gulf Publishing Co, 1989, ISBN 0872017729.

Subject Name: Material Science & Engineering					
Paper Code: CHEN 3133					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

1. The students will be able to understand the basics of materials science and be familiar with all types of engineering materials and able to determine the crystal structure by XRD technique and properties used in engineering & technology development works.
2. The students will be able to apply the knowledge in correlating the material processing techniques to the materials structures, in turn to the properties and ultimately performance or applications of the materials and also to stengthen or improve the properties of materials for better quality.
3. The students will be able to identify any structural defects of the materials used in emgineering applications at micreo oe macro level and take corrective actions accordingly in the processing techniques or by introducing other processing techniques like heat treatment of metals or curing techniques of polymer, rubber etc.
4. The students will acquire adequate understanding about the phase diagramm of different valuable and commonly used alloys and materials in engineering and do necessary modifications in the composition of the materials like pure metals, alloys like steel, brass etc, polymeric materials, ceramic and composites like FRP, RC casting, Plywood boards, high performance cutting tools, Cermets etc.
5. The students will be knowledgable in eliminating or introducing structural defects or foreign elements in the original crystal lattice of the materials like preparation of innovative alloys, p & n - type semiconductors, piezoelectric materials etc so as to tailor the properties of the materials according to requirement.
6. The students will acquire basic knowledge about extraction processes of ferrous and nonferrous metals from the naturally occuring ores and deposits and shall be fit for working in metallurgical laboratories and manufacturing industries.

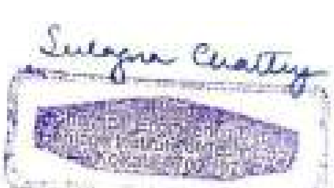
Module I: 10L

Structure of materials-Various types of bonds; Crystalline Structure of Solids- concepts of unitcell and space lattice, packing factor;

X-ray diffraction for determining crystal structure; Mechanical properties: Strength, hardness, toughness, ductility, brittleness of Engineering Materials**;** Elastic, Anelastic and visco-elastic behaviour of materials; Electrical, Electronic, Optical & Optoelectronic properties of material; Inorganic & organic amorphous materials and their structural & property characteristics; Optical fibers.

Module II: 10 L

Mechanism of plastic deformation, slip and twinning, structural imperfections: elementary concepts of point, line, surface & volume imperfections; Influence of dislocations/Line imperfections on the mechanical properties



of materials; Strain hardening and recrystallisation; Elementary aspects of creep, fatigue, fracture; Phase Diagrams- Solidification and structure of metals, Grain boundaries; Phase equilibrium and phase diagrams of binary alloys; Phase diagram of ternary systems; Iron-Carbon diagram; Heat Treatment –Introduction and purposes of heat treatment; T-T-T diagram; Corrosion-Concepts and forms of corrosion; Corrosion Mechanism and prevention; Protective materials and coating.

Module III: 10 L

Basic principles of metal extraction: Pyrometallurgy: Smelting, calcinations, roasting—oxidizing, predominance area diagrams, multiple hearth, flash and fluo-solid, sintering, smelting, slag and its classification.

Steelmaking process flow diagram: Iron making (Operation involved in Blast furnace)– Steel making (oxygen blown converter –LD) – Secondary steel making / refining (ladle processing, vacuum degassing, ladle furnace processing) – Continuous casting – with emphasis on application of the concepts of physicochemical principles involved, moving/packed bed reactor, gas-liquid two-phase flow, heat transfer with phase change (solidification).

Module IV: 10 L

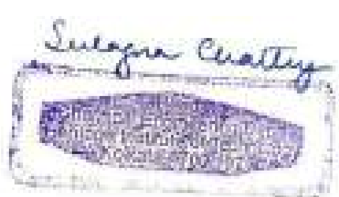
Principles of Hydrometallurgy and Electrometallurgy, Extraction of Aluminum: Hall-Heroult process, Electrolytic refining; Sources of Zinc & Copper: Pyro & Hydro metallurgical extraction of copper & Zinc; Extraction of Lead, Recent development in Lead smelting.

Text Books:

1. Raghavan, V. Material Science and Engineering, (5th Edition) V. Raghavan Prentice-Hall of India Pvt. Ltd., 2004;
2. Ray, Sridhar & Abraham. Extraction of non ferrous metal, 1985, EWP, New Delhi.
Sevryukov N.,

References:

1. Elements of Material Science and Engineering, by Lawrence, H. Vanvlack; Published by Pearson Education, 1980.
2. Engineering Physical metallurgy; Lakhtin, Y. Published by MIR Publishers, Moscow, 1975.
3. The Reduction of Iron Ores, by L. Von Bogdandy and H.J Engell Published by Springer- Verlag, New York.
4. Engineering in Process Metallurgy, by R.I.L Guthrie Oxford University Press (Paperback edition 1992).



Subject Name: Process Dynamics, Instrumentation and Control					
Paper Code: CHEN 3201					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

After completion of the course the students will be able to:

1. Explain the basic principles & importance of process control in industrial process plants.
2. Specify the required instrumentation and final elements to ensure that well-tuned control is achieved.
3. Explain the use of block diagrams & the mathematical basis for the design of control systems.
4. Knowledge on the use of Laplace transform in the control system for different forcing function.
5. Explain the importance and application of good instrumentation for the efficient design of feedback and feed forward control system.
6. Knowledge on the control strategies for different control configuration and controller tuning.

Module I [10 L]

Introduction: Principles of measurement. Error Analysis, Static and dynamic characteristics of instruments.

Temperature measurement: Filled system Thermometer, Thermocouples, Resistance Thermometers, radiation and optical pyrometers;

Pressure: Manometers: U tube manometer, inclined limb manometer, Ring balance manometer, Elastic deformation: bourdon, bellows, diaphragm and electrical type gauges: strain gauge, piezoelectric, pressure transducers.

Vacuum gauges: mechanical, electrical and ionization types;

Flow: Head flow meters, area flow meters, positive displacement flow meters, mass and magnetic flow meters;

Level: Direct and inferential type; composition.

Module II [10L]

Introduction to process control, Use of Laplace transforms in process control, Different forcing functions: Step, Pulse, Impulse, Ramp, Sinusoidal and frequency inputs & their graphical representation.

First order system; Transfer function; Examples of First Order Systems, Pure capacitive system, Response of different forcing functions; First order systems in series- non- interacting & interacting. Second order system- Under- damped, critically damped & over damped, Second order system examples - Damped vibrator, Control valve, U-tube manometer, terms related to under damped system, Transportation lag.

Module III [10 L]

Feedback control loop and its components, advantages and disadvantages of feedback control system Simple process models and their transfer functions**:** stirred tank heater, continuous stirred tank reactor, heat exchanger, distillation column, U-tube manometer.

State-space representation of linear systems.

Different types of controllers and their applications: P, PI, PD, PID & their transfer function, servo and regulatory control, transient responses of feedback control systems.

Block diagram: Block diagram of different chemical process units, block diagram reduction, open loop & closed loop transfer function, concept of poles and zeros.
Control valves: construction, types of control valves, characteristic curves & transfer function, valve sizing, applications.
Elementary idea of feed forward, cascade, ratio control.

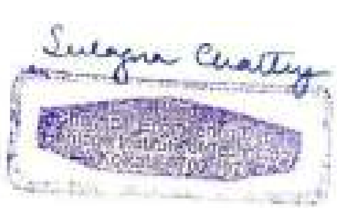
Module IV [10L]
Definition of stability, concept of bound and unbound function.
Stability Analysis of Feedback control systems: Routh-Hurwitz stability criterion, Direct Substitution method, Root Locus Analysis, Frequency response analysis, Bode plot and Bode stability criterion, Nyquist stability criteria.
Performance Criteria for good control (ISE, ITAE, IAE etc), concept of empirical process models, development of empirical process models: FOPDT, SOPDT etc and evaluation of their performance, Process reaction curve method, Zeigler-Nichols and Cohen Coon controller tuning rules, and determination of controller settings.
Adaptive & digital control, concept of PLC & DCS.

Text books:

1. Process system analysis & Control-D.R. Coughanowr, McGraw-Hill, Inc., 2^{nd} ed., 1991.
2. Chemical Process Control: An Introduction to Theory and Practice-George Stephanopoulos, pHI, 1^{st} ed., 1984.
3. Industrial Instrumentation-D. P. Eckman, Wiley Eastern Ltd., 1^{st} ed., 2004.

Books of reference :

1. Principles of Industrial Instrumentation-D. Patranabis, Tata McGraw Hill, Publishing Ltd., 1^{st} ed., 1999.
2. Process Dynamics and Control-D.E. Seborg, T.F. Edgar, and D.A. Mellichamp, John Wiley & Sons,2^{nd} ed., 2004.
3. Industrial Instrumentation Fundamentals-A.E. Fribance, McGraw-Hill, Kogakusha, 1962.
4. Process Control Modelling, Design and Simulation-B. Wayne Bequette, Prentice Hall, 1957.
5. Process Modelling, Simulation and Control for Chemical Engineers-William L. Luyben, McGraw Hill, 1990.



Subject Name: Project Engineering					
Paper Code: CHEN 3202					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

1. The students will be able to understand the basics of project engineering and aply that to organise the activities of project engineering including the plant & equipment deign and economic analysis for the project.
2. The students will be able to apply cost and profitability analysis for the project under considerations and study the preliminary feasibility of the project.
3. The students will be able to implement innovative ideas to optimisation of the plant design componenets in regard to requirement of energy , time and ultimately cost.
4. The students will be able to apply energy integration techniques (pinch technology) to reduce the external energy supply in addition to that generated in the process.
5. The students will be able to prepare network of activities involved in project for plant design or other business processes and critically examine the schedule for the completion of the project and cost impacts for the project.
6. The students will be able to carry out the final feasibility study and and economic assessment for the design of a new plant or expanding an existing business by taking recourse to critical path method or project eavaluation & review technique for reporting the success of the project.

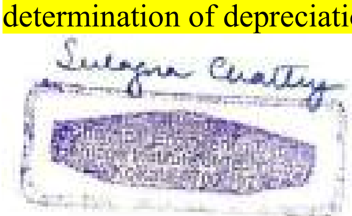
Module I: 10L

Role of a Project Engineer, Development of Laboratory bench scale experiment to pilot & semi- commercial plant operation, scale up and scale down techniques, pre-design cost estimations, fixed capital and working capital, manufacturing cost, plant location and plant lay out, plant utilities, safety measures.

Time value of money, simple interest, nominal and effective interest rates, compound andcontinuous interest, present worth and discount, annuity, perpetuity and capitalized costs, Pay outperiod.

Module II: 10L

Depreciation: Types of depreciation, Depletion, concepts of service life, salvage value, and book value, straight-line method, Declining balance method, sum of the years digit method and sinking fund method for determination of depreciation, modified accelerated cost recovery system (MACRS),



Alternative investment, Choices among various alternatives, Replacements, Methods of profitability evaluation for replacements, Return on investment, Net present worth (NPW),

Discounted cash flow rate of return (DCFR), Effect of inflation on profitability, income taxes, GDP and national growth..

Module III: 10L

Optimum Design and Design strategy: Basic principle of Optimum Design, general procedure for determining optimum conditions, Breakeven analysis, Optimum production rate in plant, determination of optimum economic pipe diameter and optimum flow rate in condenser, minimum cost analysis, economics in selection of materials.
Basic concepts of process integration, Pinch analysis.

Module IV: 10L

Project scheduling: Bar chart, Milestone chart, Concept of network analysis: Numbering network, PERT, CPM, statistical distribution associated with PERT network, Earliest expected time and latest allowable occurrence time calculation, Slack, determination of critical path, concept of float.

Text Book:

1. Plant Design and Economics for Chemical Engineers -- Peters and Timmerhaus andWest, Mc Graw Hill, 5th Ed., 2003
2. PERT and CPM – Principles and Applications, Affiliâted East West, 3rd Ed., 1989

References:

1. Chemical Engineering Design – Coulson and Richardson, Volume 6, Elsevier, 5th Ed., 2009

Subject Name: PEDD II					
Paper Code: CHEN 3211					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**3**

Course Outcome:

After completion of the course students will be able to

1. understand the basics of process equipment design and important parameters of equipment design.
2. understand of process equipment accessories & support systems.
3. design different types of heat exchangers including condenser, boiler, shell and tube heat exchanger
4. design special vessels (e.g. tall vessels) and various parts of vessels (e.g. heads, nozzels etc.).
5. design different flow measuring devices like venturimeter, orifice-meter etc.
6. understand the operation of process equipment like heat exhangers, flow measuring devices anddraw different sectional view of them using AUTOCAD.

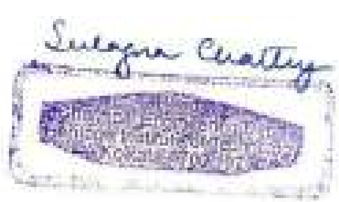
1. Design and Drawing of Heat Exchanger.

2. Design and Drawing of Orifice meter / Venturi meter/ Rotameter (Anyone).

Text Book / References:

1. Process Equipment Design – Brownell and Young, John Wiely and sons.

2. Chemical Engineering Design, Fourth Edition: Chemical Engineering Volume 6 (Coulson & Richardson's Chemical Engineering) 4th Edition - by R K Sinnott (Author), Butterworth-Heinemann; 4 edition.



Subject Name: Numerical Methods Laboratory					
Paper Code: CHEN 3212					
Contact Hours PerWeek	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcome:

After completion of the course the students will be able to

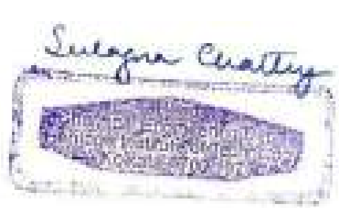
1. **Illustrate** the basics of MATLAB or equivalent software programming.
2. **Develop** the logic for the chosen numerical method.
3. **Build** MATLAB or equivalent software code to apply the logic.
4. **Inspect** written code for syntactical and logical error.
5. **Assess** the code to obtain correct solutions after correcting the errors.
6. **Compile** the final outcome of the given problem with expected result either in numeric or ingraphical representation.

Module- I: Numerical Methods (Programming language: Matlab)

1. Solution of Linear System by Gauss Elimination method and Gauss-Seidel iterative method: Steadystate solution of isothermal CSTR in Series in which a first-order reactionis taking place.
2. Solution of a non-linear equation by Newton-Raphson method.

3. Solution of a set of non-linear equations by Newton method: steady-state solution ofa non-isothermal CSTR in which a first-order reaction is taking place.

4. Solution of one-dimensional unsteady state heat conduction problem using Taylor series based Finite Difference Method – Explicit scheme, Implicit scheme using Tri-diagonal Matrix Algorithm (TDMA).
5. Numerical solution of ODEs by Runge-Kutta method : Unsteady-state solution of Multiple reactions in a CSTR or Binary distillation column.



Subject Name: Nanotechnology					
Paper Code: CHEN 3231					
Contact	**L**	**T**	**P**	**Total**	**Credit Points**
Hours PerWeek	**3**	**0**	**0**	**3**	**3**

Course Outcome:

After completion of the course the students will be able to

1. Exhibit knowledge of the fundamentals of solid state physics, lattice and atomic structure, energy bands and different types of bonding in matter.
2. Classify the various types of process used in nano-manufacturing of 1D, 2D and 3D nanostructures
3. Identify the processes necessary to build a particular nano structure.
4. Exhibit knowledge of the relevant physical, chemical, mechanical, electrical and optical properties of materials in nano configuration.
5. Exhibit understanding and decide on measurements and instruments used for characterizing ananomaterial.
6. Construct the processing steps and identify materials necessary to build a particular nano structure.

Module I : 10 L
Introduction to the physics of solid state; Structure & Bonding.Elements of nanoscience & nanotechnology.

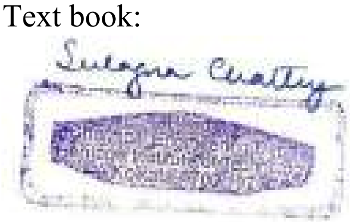
Module II : 10 L
Synthesis of nanomaterials: General approaches, Physical Methods, Chemical Methods &Biological Methods;

Properties of nanomaterials: Mechanical, Structural, Thermal, Electrical & Optical properties.

Module III : 10 L
Characterization techniques of nanomaterials: Microscopy; Spectroscopy; & Diffraction techniques; Some special nanomaterials: Carbon nanotubes, Porous silicon, Zeolites, Aerogels,Core-shell nanoparticles.

Module IV : 10 L
Application: Nanolithography, Nanocomposites, Nanoparticles as catalyst, conductingpolymers; nanotechnology: DNA Nanowires, Nanomedicines

Text book:



1. NANOTECHNOLOGY: Principles & Practices; Sulabh K. Kulkarni, SpringerInternational Publishing, 2015

Subject Name: Bioprocess Engineering					
Paper Code: CHEN 3233					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. Ability to solve biochemical reaction engineering problems through logic.
2. Ability to utilize experimental data for predicting rate equation for both enzymatic and live cell fermentation process.
3. Ability to design bioreactors for free enzymatic reaction under enzyme uninhibited/inhibited conditions.
4. Ability to use principles of bioprocess engineering for selecting and designing suitable contacting device for immobilized enzyme reactions under mass transfer/bioreaction control condition.
5. Ability to select suitable bioreactor and its design and scale up for whole cell catalyzed reactions.
6. Ability to apply suitable modern separation techniques for isolation, purification and quantitative separation of target bio molecule from live cells.

Module I [10 L]

Principles of enzyme catalysis Proteins as enzymes; Michaelis-Menten kinetics; Briggs Halden theory Kinetics and Statistics; Inhibition; Effect of pH and temperature; Enzymology; methods of immobilization, diffusional limitations in immobilized enzyme systems.

Module II [10 L]

Microbial growth Introduction to metabolism; Nutrient transport; Glycolysis; TCA cycle and other pathways; Control of metabolism; Factors affecting microbial growth; Stoichiometry: mass balances; Stoichiometry: energy balances; Growth kinetics; Measurement of growth.

Agitation and aeration**:** types of impellors and sparger, oxygen transfer rate, oxygen uptake rate, volumetric oxygen transfer rate (kLa), measurement of $k_L a$, power requirement for agitation in gaseous and non gaseous systems.

Module III [10L]

Bioreactors Introduction to bioreactors; Batch and Fed-batch bioreactors, Continuous bioreactors; Immobilized cells; Bioreactor operation; Sterilization; Aeration; Sensors; Instrumentation; Culture-specific design aspects: plant/mammalian cell culture reactors.

Scale up, operation and control of bioreactors**:** Concepts of various bioreactor configurations, scale-up, various criteria for scale-up, scale-down, bioreactor instrumentation and control.

Module IV [10 L]

Bioseparations Biomass removal; Biomass disruption; Membrane-based techniques; Extraction; Adsorption and Chromatography.

Industrial Processes and Process economics Description of industrial processes; Process flow sheeting; Process economics.

Subject Name: Seminar I					
Paper Code: CHEN 3221					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**0**	**0**	**2**

A Seminar topic will be allotted to individual student according to his/her subject of interest. A thorough report should be prepared based on which seminar presentation and question-answer session will be conducted. Assessment of the student would be done by the faculty members on the basis of presentation, performance in the question - answer session and the report submitted, giving equal weightage on each component.

Seminar Courses will enable the student to carry out independent review of existing and novel developments in Chemical Engineering Science. The courses will also enable them to develop presentation and communication skills.

Subject Name: Design of Heat Transfer Equipments					
Paper Code: REEN5141					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module1: [10L]

Fundamentals of heat transfer: steady state heat conduction through plane wall, composite wall, heat transfer resistance in series and parallel, conduction with heat generation, convective resistance, critical insulation thickness, steady state heat conduction through extended surface, fin efficiency, dimensionless number for convection, empirical correlation for free and forced convection. Correlation of heat transfer coefficient for condensation and boiling

Module 2: [10L]

Classifications of heat exchangers, overall heat transfer coefficient, LMTD and LMTD correction factor, fouling factors, Effectiveness and number of transfer unit of heat exchangers, sizing and rating problems of heat exchanger design. Flow and stress analysis: Effect of turbulence, friction factor, pressure loss, stress in tubes, header sheets and pressure vessels design, thermal stresses, shear stresses - types of failures.

Module 3: [10L]

Kern method of Heat Exchanger Design: Double-pipe heat exchanger, shell and tube heat exchanger, condenser and boiler design. Details of shell and tube heat exchanger construction. Design and construction of furnace, recuperator, regenerator and economiser. Heat exchanger network and its optimization.

Module 4: [10L]

Types of Compact heat exchanger, merits and demerits, design of compact heat, exchangers, plate type heat exchangers, performance influencing parameters, limitations, Design of surface and evaporative condensers, cooling tower, performance characteristics.

Text/ Reference Book:

1. Process Heat transfer by D.Q. Kern Tata McGraw-Hill Education, 1997
2. Arthur. P Frass, Heat Exchanger Design, John Wiley & Sons, 1988
3. Taborek.T, Hewitt.G.F and Afgan.N, Heat Exchangers, Theory and Practice,

McGraw- Hill Book Co. 1980.
4. Fundamentals of Heat Exchangers Design by Ramesh K. Shah and Dusˇan P. Sekulic
John Wiley & Sons, Inc., 2003

Subject Name: Internship					
Paper Code: REEN5221					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**0**	**0**	**2**

Students will be sent for training to an industry for a period of 4 to 6 weeks after completion of 1^{st} Semester examination. After completion of the training the students will submit a comprehensive report consisting of general overview of the plant, process description of with process flow diagram, details of different equipments with specifications, process instrumentation and control, product with production capacity, raw materials utility and energy consumed per unit of product**.** Assessment would be made on the basis of the submitted report and the viva voce examination conducted by a board of examiners constituted by the Departmental Academic Committee consisting of two faculty members and training coordinator with Head of the Department as Chairman during 2^{nd} Semester examination

Subject Name: Seminar -II					
Paper Code: REEN5222					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

A Seminar topic will be allotted to individual student according to his/her subject of interest. The seminar topic must be different from the topic already presented in Seminar-I. Topic of the seminar should not be on internship training. A thorough report should be prepared based on which seminar presentation and question- answer session will be conducted. Assessment of the student would be done by the faculty members on the basis of presentation, performance in the question - answer session and the report submitted.

Seminar Courses will enable the student to carry out independent review of existing and novel developments in Renewable Energy field. The courses will also enable them to develop presentation and communication skills.

ELECTRICAL MACHINE II

CODE: ELEC3101 **CONTACT: 3L+1T**

At the end of this course students will be able to

1. Able to solve complex electrical engineering problem related to operating principle of three phase IM and analyze the performance of three phase IM
2. Able to analyze the performance and starting of single phase Induction Motor with their uses depending on the torque speed characteristics.
3. Apply the knowledge of special motors for solving complex engineering problems related to various application of special electromechanical devices.
4. Identify and analyze the complex problems related to operation, installation and commissioning of Synchronous machines reaching substantiated conclusion using fundamental concept of Synchronous Machines.

MODULE I

Three Phase Induction Motor(IM) : Construction. Type and operating principle. Flux and MMF phasor in Induction motors. e.m.f equation. Determination of equivalent circuit parameters by No load & Block rotor test. Efficiency of 3-ph IM. Torque-slip characteristics. Conditions for maximum torque at start and run. Deep bar and double cage rotor. Methods of starting and speed control. Crawling & Cogging phenomena. Application of Polyphase Induction motor. Induction generator. [10L]

MODULE II

Single Phase Induction Motor : Construction. Double revolving field theory. Cross field theory. Starting methods. Speed-Torque characteristics. Phasor diagram. Determination of equivalent circuit parameters by No load and Block rotor test. Condition of Maximum torque. Applications. [6L]

Special Electromechanical Devices: Switched Reluctance motor. Stepper motor. Brush less DC machines. Application of A.C series motor. [4L]

MODULE III

Synchronous Generator: Construction and operating principle. Different excitation systems. Armature reaction. Theory for salient and non-salient pole machine. Two reaction theory. Transient and subtransient reactances during short circuit condition. Determination of synchronous machines parameters under steady state and transient condition. Phasor diagram of alternator under different types of loads. Operating characteristic of alternator. Determination of voltage regulation by Synchronous impedance method, M.M.F. method. Potier triangle method. Synchronous machine connected to infinite bus. Effect of change of excitation and speed of prime mover. synchronization of alternator. Power flow and power angle characteristic. Synchronizing power [14]

MODULE IV

Synchronous Motor: Construction and operating principle of synchronous motor. Damper winding. Method of starting. Phasor diagram. V curve under lagging and leading p.f, Under excitation and over excitation. Synchronous Condenser. Power factor control , Hunting. Applications. [6]

Text Books	Reference Books :
1. Electrical Machinery by Dr. P.S. Bimbhra. 2. Generalized Theory of Electrical Machines by Dr. P.S. Bimbhra 3. Electrical Machines by P. K. Mukherjee & S. Chakravorty 4. Electrical Machinery by S.K.Sen 5. Theory of Alternating Current Machinery by Alexander S Langsdorf	1. The Performance And Design Of Direct Current Machines by Clayton & Hancock. 2. The Performance And Design Of Alternating Current Machines by M.G.Say. HOD, EE

POWER SYSTEM - I
Code: ELEC3102
Contact: 3L+1T

COURSE OUTCOME

Students will be able

1. To learn about the basic structure of Power System.
2. To learn about the methods and components used in conventional power generation plants.
3. To learn about various means of power transmission.
4. To learn about the mechanical design of power transmission system.
5. To learn about the electrical parameters involved in power transmission system.
6. To learn the representation of the transmission lines and analyze their performance.
7. To learn about the components of distribution system and improve their performances.

MODULE – I

Introduction: Structure of a power system-Generation, transmission and distribution configurations. Choice of voltage and frequency.

Generation of Electric of Power: General layout of a typical coal fired power station, Hydro electric power station, Nuclear power station, Gas –turbine power station, their components and working principles, comparison of different methods of power generation. (9L)

MODULE – II

Overhead transmission line: Types of conductors, Skin effect and Proximity effect. Inductance and Capacitance of single phase and three phase (symmetrical and unsymmetrical) line, Charging current, Transposition, Bundle and composite conductors, GMD and GMR. Influence of earth on conductor capacitance.

Power Cables : Types of cables, insulation Resistance, stress and capacitance of single and multicore cables, grading of cables, sheath effects, dielectric loss. Comparison of cables and overhead lines.

(12L)

MODULE – III

Mechanical design of transmission line: Calculation of sag of Transmission lines, Variation of sag with wind and ice load, stringing chart.

Insulators: Types of Insulators, Potential distribution over a string of Suspension Insulators, String efficiency, Methods of Equalizing the Potential.

Corona: Principle of Corona formation, Critical disruptive voltage, Visual critical corona discharge potential , Corona loss, advantages & disadvantages of Corona, methods of reduction of Corona. (8L)

MODULE – IV

Transmission System: Short, Medium and Long transmission lines and their representation. ABCD constants, Ferranti effect, Surge Impedance Loading, Active and reactive power flow through transmission lines, Power Circle diagram.

Distribution Systems: Feeders, distributors, and service mains; Types of distribution systems- Radial, Ring Main; Interconnector ; Kelvin's law for design of feeders.
Power factor correction and Tariff. (11L)

HOD, EE

Text Books:

1. Modern Power System Analysis, D.P. Kothari & I.J. Nagrath, 4th Edition, Tata McGraw Hill.
2. Elements of power system analysis, C.L. Wadhwa, New Age International.
3. Electrical Power System, Ashfaq Hussain, CBS Publishers & Distributors

Reference Books:

1. Power System Analysis by Grainger & Stevenson, Tata McGraw Hill
2. Power System analysis by H.Cotton

SIGNALS AND SYSTEMS
CODE: ELEC3103
CONTACT: 3L

COURSE OUTCOMES OF SIGNALS AND SYSTEMS

Students will be able to

- understand the concept of signals
- analyze the spectral content of different signals
- find Z and inverse Z transforms
- determine the mathematical model of physical systems
- model different systems by state variable approach

Module-I

Signals: Concept of Signals, Continuous and discrete time signals, Classification of Signals: Periodic and aperiodic, even and odd, energy and power signals, Deterministic and random signals, Exponential, sinusoidal signals. Decomposition of signals into odd and even components. Singularity functions- step, ramp ,impulse and doublet signals. Properties of Impulse Function. Decomposition of simple aperiodic waveforms in terms of singularity functions,. Transformation of signals: time scaling; time shifting. Convolution Theorem. **[6L]**

Fourier Series & Transform: Dirichlet's conditions, Fourier series-trigonometric and exponential. Fourier transform of aperiodic functions. Generalized Fourier transform. Properties of Fourier transform. **[6L]**

Module-II

Sampling: Representation of continuous time signals by its samples –Types of sampling, Sampling theorem. Reconstruction of a signal from its samples, aliasing. **[3L]**

Z-Transforms: z-transform definition, mapping between s-plane and z-plane, unit circle in z plane, region of convergence (ROC), properties of ROC. Properties of z-transform, Poles and Zeros, inverse z-transform using Residue Theorem, Power Series expansion and Partial fraction expansion. **[5L]**

Module-III

Systems: Concept of Systems, Classification, Differential equation representation of systems, Definition of Linear Time invariant (LTI) systems. Concept of transfer function, Poles and zeros. Time and frequency response of first and second order systems. **[6L]**

Modeling of Dynamic Systems: Mechanical systems (translational systems and rotary systems) electromechanical systems (DC Servo motor and PMMC). Electrical analogous systems. **[5L]**

HOD, EE

Module-IV

State space analysis: State variable representation of systems, Normalization of linear equations. Converting higher order linear differential equations into State Variable (SV) form. Obtaining SV model from Transfer Function. Obtaining characteristic equations and transfer functions from SV model. State variable representations of electrical and mechanical systems. Solutions of state equations. State transition matrix. Properties of state transition matrix. **[9L]**

Total: 40L

Text Books:

1. Signal Processing & Linear Systems, B.P.Lathi, Oxford
2. Signals and Systems, A.Nagoor Kani, McGraw Hill
3. Signals and Systems, S.Haykin & B.V.Veen, John Wiley
4. Signals and Systems, T.K.Rawat, Oxford

Reference books

1. Kuo, B. C; "Automatic Control System" Prentice Hall of India
2. Lindner D. K; "Introduction to signals and systems", McGraw Hill
3. C-T Chen- Signals and Systems- Oxford
4. Network Analysis & Synthesis, F.F Kuo., John Wiley & Sons

Data Structure and Database Concept
Paper Code : ELEC3104
Contact: 3 L/week,
Credit: 3
Total: 45L

Data Structures

Module I: **(13L)**

Array, Structure, and Pointers in C: creation of customized data type, Array of Structure, Pointers and its application in handling array and structure.

Linear Data structures:

Singly Linked List- Insertion at beginning, at end and any position of the List. Deletion by value, by position: beginning, end and any position of the List

Stack and Queue: Both array and Linked Representation, Circular queue using array only.

Application of stack: Infix to postfix conversion, Evaluation of postfix expression.

Module II: **(10L)**

Recursion: Design of Recursive algorithm.

Non-Linear Data Structures:

Trees: Binary Trees: Array and Linked representation, Binary tree Traversal Techniques, reconstruction of binary tree using traversal sequence.

Binary Search Trees - Insertion and Deletion algorithms.

Sorting Algorithms: Bubble sort, Insertion sort, Quick sort and their comparison.

Searching Algorithms: Linear search, Binary search and their comparison.

Database Concept

Module III: (10L)

Introduction to Database Concepts, File Processing System and Database Management System, DBMS Architecture and Data Independence.

Data Model: Basic Concepts, Entity-Relationship Diagram, Keys, Cardinality, Weak Entity Set.

Introduction to relational algebra & SQL: Operators like select, project, rename, Cartesian product, join, union, intersect, minus, DDL, DML.

Module IV: (12L)

Relational Database Design: Functional Dependencies, Normalization: Different anomalies in database designing

1NF, 2NF, 3NF and BCNF, Lossless-Join Decomposition and Dependency Preservation, Introduction to Transaction Processing Concepts: ACID properties, Serializability and Recoverability

Text Books:

Data Structures:

I) Title: Data Structures.
Author: Seymour Lipschutz.
Publication: Tata McGraw-Hill (India)

II) Title: Data Structures and Program Design in C.
Author: Kruse Robert L., Robert Kruse, Cl Tondo.
Publication: Pearson Education India.

HOD, EE

Database Concept:
I) Title: Fundamentals of Database Systems
Author: Elmasri Ramez and Navathe Shamkant
Publication: Pearson.

II) Title: Database System Concepts
Author: A. Silberschatz, H.F Korth, S.Sudarshan
Publication: McGraw Hill Education (India) Private Limited

Reference Books:
Data Sturucture:
I) Title: Data Structures using C.
Author: Tanenbaum A. S, Langsam Y., Augenstein M.J.
Publication: Pearson.

II) Title: The Art of Computer Programming
Author: Donald E. Knuth
Publication: Addison-Wesley Professional

Database Concept:
I) Title: Introduction to Database Management Vol. I, II, III,
Author: Date C. J.
Publication: Addison Wesley.

II) Title: Principles of Database Systems
Author: Ullman JD.
Publication: Galgottia Publication

ELECTRONIC INSTRUMENTATION
CODE: ELEC3131
CONTACT: 3L

COURSE OUTCOMES OF ELECTRONIC INSTRUMENTATION

Students will be able to

- Understand the principle of operation of electrical transducers
- grasp the techniques to measure non-electrical quantities
- know the working principles of wave analyser and spectrum analyser
- understand signal conditioning circuits
- Acquire the concepts of data acquisition and virtual instrumentation.

Module -I

Sensors and Transducers: Introduction, Classification of Transducers, Characteristics and choices of Transducers. [1]

Temperature transducers: Resistance Temperature Detectors (RTD), Thermistors, Thermocouples and Radiation Pyrometers-construction, principle of operation, advantages and disadvantages. [6]

Resistive Strain Gauge: construction, principle of operation, application. [2]

Linear Variable Differential Transformer (LVDT): construction, principle of operation, phase-sensitive demodulation, advantages and disadvantages of LVDT, use of LVDT. [3]

Module-II

Capacitive Transducer: variable air gap, variable plate overlap, variable dielectric, differential arrangement, measurement of Displacement and Liquid level, advantages and disadvantages, use of capacitive Transducer. [3]

Piezoelectric Transducers: Fundamental concepts, materials, charge sensitivity, voltage sensitivity. Force/displacement transducers, Buffer amplifiers, charge amplifiers, Static and dynamic responses. Accelerometers. [3]

Pressure transducers: Primary sensing elements: Bourdon tube, diaphragm, bellows, Electronic pressure gauges, Capacitive pressure transducers. [2]

Measurement of Flow: Electromagnetic Flow meter, Hot wire anemometers, Ultrasonic Flow transducer. [3]

Module-III

Frequency Domain Instruments: Wave analyser, Frequency Selective wave analysers, Heterodyne Wave analyser, application of Wave analyser, Basic Spectrum analyser [4]

Special Instruments: Q meter, function generators. [3]

HOD, EE

Module-IV

Data Acquisition Systems: General Block diagram of Data Acquisition Systems (DAS), Objectives of DAS, classification of DAS, Applications of DAS [2]

Signal Conditioner: Review of digital to analog and analog to digital converters, Sample and hold circuit, Multiplexing, Analog to Digital Multiplexing, Digital to Analog Multiplexing, Analog Multiplier. [5]

Virtual Instrumentation: Virtual Instruments versus Traditional Instruments, Software in Virtual Instrumentation, Virtual Instrumentation in the Engineering Process [1]

Total: 38L

TEXT BOOKS:

1. Modern Electronic Instrumentation & Measurement Techniques : by Helfrick & Cooper
2. Transducer & Instrumentation, D.V.S Murty,PHI
3. A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & sons.
4. Sensors & Transducers : by D. Patranabis
5. Electronic Instrumentation : by Oliver & Cage

HOD, EE

REFERENCE BOOKS:

1. Measurement Systems: by Ernest Doebelin
2. Instrument Measurement & Analysis : By Nakra & Chaudhry
3. Principles of Measurement Systems : by John P. Bentley

ILLUMINATION ENGINEERING
CODE : ELEC 3132
CONTACT: 3L
Credit : 3

COURSE OUTCOME

- To get acquainted with the laws of photometry for calculation of illuminance levels for different lighting applications
- To understand the principles of operation of different photometers
- To understand the principles of operation of different lamps and their accessories
- To analyse indoor lighting schemes and design energy efficient installations complying with lighting codes
- To design energy efficient road lighting installations in conformity with lighting codes
- To understand the parameters of sports lighting installations

Module – I **[9L]**
Illumination Engineering Basics and Photometers
Light and Electromagnetic Radiation, Visible spectrum of radiation.
Radiometric and photometric quantities, visual response curve of standard observer, relation between Lumen and Watt.
Laws of Illumination, perfect diffuser, Lambert's law.
Bench photometer, luxmeter, distribution photometer, integrating sphere.

Module – II **[9L]**
Lamps and its Accessories: Incandescent lamps, tungsten halogen lamps, fluorescent tubes, compact fluorescent lamps (CFL), low and high pressure sodium vapour lamps, high pressure mercury vapour lamps, metal halide lamps, Light Emitting Diode (LED) lamps.
Ballast- function, electromagnetic and electronic types, principles of operation.

Module – III **[9L]**
Interior Lighting Design
Objectives, quantity and quality of light, selection of lamps and luminaires. Design considerations for lighting of offices, conference rooms, hospitals. Design calculations by lumen method in accordance with lighting code.

Module – IV **[9L]**
Outdoor Lighting : Road, Playground and Landscape Lighting Design
Basic concepts of outdoor lighting design- objectives, design parameters, qualitative & quantitative evaluation of outdoor lighting systems.

References / Books

1. Lighting Engineering Applied Calculations – R. H. Simons & A.R. Bean, Architectural Press
2. Applied Illumination Engineering, Second Edition, Jack L Lindsey, Prentice Hall.
3. Lamps and Lighting – Edited by J.R.Coaton and A.M.Marsden, 4th Edition Arnold
4. IES Lighting Handbook – IES North America.
5. National Lighting Code- Published by Govt of India,2011

HOD, EE

ELECTRICAL MACHINE LAB-II
CODE: ELEC 3111
CONTACT HR: 3P

List of Experiments:

1. Different methods of starting of a 3 phase Cage Induction Motor & their comparison [DOL, Auto transformer & Star-Delta]
2. Speed control of 3 phase squirrel cage induction motor by different methods & their comparison [voltage control & frequency control].
3. Speed control of 3 phase slip ring Induction motor by rotor resistance control.
4. Determination of regulation of Synchronous machine by
   a. Potier reactance method.
   b. Synchronous Impedance method.
5. Determination of equivalent circuit parameters of a single phase Induction motor.
6. Load test on single phase Induction motor to obtain the performance characteristics.
7. To determine the direct axis resistance [Xd] & quadrature reactance [Xq] of a 3 phase synchronous machine by slip test.
8. Load test on wound rotor Induction motor to obtain the performance characteristics.
9. To make connection diagram to full pitch & fractional slot winding of 18 slot squirrel cage Induction motor for 6 poles & 4 pole operation.
10. To study the performance of Induction generator.
11. Parallel operation of 3 phase Synchronous generators.
12. V-curve of Synchronous motor
13. Determination of equivalent circuit parameters of 3 ph induction machine
14. Performance of 3 ph squirrel cage induction motor

HOD, EE

POWER SYSTEM – I Lab
Code: ELEC3112
Contact: 3P

---

1. Determination of the generalized ABCD Constant of a long transmission line
2. Dielectric strength test of insulating oil
3. Determination of break down strength of solid insulating material
4. Measurement of earth resistance by a Earth-Tester
5. Determination of Phase Sequence Test of a given Three Phase Supply
6. Simulation of DC distribution by network analyzer for Single-end fed system
7. Simulation of DC distribution by network analyzer for Double-end fed system
8. Study and analysis of an electrical transmission line circuit with the help of PSPICE
9. Study of different types of insulators

HOD, EE

SIGNALS & SYSTEMS LAB.
CODE: ELEC3113
CONTACT: 3P

1. The generation of different type of continuous and discrete signals using MATLAB.
2. Spectrum analysis of different signals.
3. Study of aliasing phenomenon and convolution.
4. Time response of first and second order systems for step, ramp and impulse input.
5. Study of performance indices of second order system excited by step input.
6. Frequency response of first and second order systems.
7. Determination of z- transform and inverse z transform using MATLAB.
8. Obtain Transfer Function of a given system from State Variable model and vice versa using MATLAB.
9. Obtain the step response and initial condition response of SISO and MIMO systems in SV form by simulation.

HOD, EE

DBMS Laboratory
Paper Code : ELEC3114
Contact : 3 hours /week
Credit : 2

Experiments on Database on RDBMS Platform (Oracle):
DDL Commands: Creating Tables along with constraints like: Primary Key, Foreign Key, unique, Not Null, Check. Altering Table Structure like adding and modifying constraints, adding and modifying column data types, etc.
DML: Inserting rows, Updating rows, Deleting rows
SQL Query: Cartesian Product, All types of Join, Union, Intersect, Minus, Single Row functions, multiple row functions using GROUP BY clause, ORDER BY Clause, Nested Sub-Queries
Introduction to PL/SQL: Programming Language Constructs in PL SQL like variable declaration, Conditional Statements, different types of loop structures, functions, etc. Programming using Cursors.

Books:
DBMS Laboratory
Title: SQL, PL/SQL: The Programming Language Of Oracle (With CD-ROM) (English) 4th Revised Edition
Author: Ivan Bayross
Publisher: BPB Publications

HOD, EE

B.Tech in Electrical Engineering
3rd Year 2nd Semester

POWER SYSTEM-II
Code: ELEC3201
Contact: 3L+1T

COURSE OUTCOME

Student will be able

1. To learn the representation of power system components by equivalent per unit reactance diagram.
2. To learn to perform various power system analyses like fault analysis, power flow and stability analysis.
3. To learn the basic principles of Power System relaying.
4. To learn the basic principle of Circuit Breaking.
5. To learn the protection schemes for different power system components.

HOD, EE

MODULE – I

Representation of Power system components: Single-line diagram of balanced three phase system, Impedance & Reactance diagram, Per unit system representation, Base values-phase and line quantities.

Symmetrical & Unsymmetrical Fault Analysis: Transient on a transmission line, short circuit of a synchronous machine under no load & loaded condition. Symmetrical component transformation, sequence impedance and sequence network of power system.

Symmetrical fault analysis.

Symmetrical component analysis of unsymmetrical faults, single line-to-ground fault, line-to-line fault, double line-to-ground fault. [11L]

MODULE – II

Power system stability: Classification of power system stability – voltage stability, Rotor angle stability/ steady state stability, transient stability, equal area criteria, swing equation, multi machine stability concept.

Load flow Analysis: Load flow problem, Y-bus Formulation of problem, Solution technique using Gauss-Seidal method, Newton-Raphson method [10L]

MODULE – III

Basic principles of power system protection, block diagrams of protective schemes and fundamental principles of Induction relay. Single input relays, Principle and application of non-directional & directional over current and earth fault relays. Distance relays, Differential relays. Basic aspects of static relay.

Protection schemes for transformer, generators and motors. [10L]

MODULE – IV

Circuit Breaker : General requirements of circuit breakers. Formation of electric arc, quenching theories, recovery voltage and RRRV, Arc re-striking phenomena. Problems in capacitive and low inductive current interruptions. Rating of circuit breakers.

Different types of circuit breakers - their operating mechanisms & applications. Testing of circuit breakers. D.C circuit breaking.

Substation grounding [9L]

Text Books:

1. Modern Power System Analysis, D.P. Kothari & I.J. Nagrath, 4th Edition, Tata McGraw Hill.
2. Power System Analysis by Grainger & Stevenson, Tata McGraw Hill
3. Switchgear protection and power systems, Sunil S Rao, Khanna Publications.
4. Elements of power system analysis, C.L. Wadhwa, New Age International
5. Power System Protection and Switchgear, B. Ravindranath, M. Chander

Reference Books:

1. Protection & Switchgear, B. Bhalja, R.P. Maheshwari, N.G.Chothani, Oxford.
2. Power system protection & switchgear, B.Ram & D.N. Vishwakarma, Tata McGraw Hill.
3. Power System Stability & Control - Prabha Kundur
4. Power Systems Stability, Vol. I,II& II, E.W. Kimbark, Wiley.
5. Power Systems Analysis, A. R. Bergen & V. Vittal, Pearson Education.
6. Power System Operation by James Malinowski , Robert Miller
7. The Art and Science of Protective Relaying by C. R. Mason, John wiley & Sons

Power Electronics
Paper Code: (ELEC3202)
Contact: 3L

Course Outcomes:

Students will be able to

- Understand the basic theory and characteristics of power semiconductor devices.
- Analyze basic converter (AC-DC, DC-DC, DC-AC, AC-AC) topologies.
- Understand and design single-phase and three-phase thyristorized converters.
- Learn the application of power electronics in electric drives.
- Understand role of Power Electronics in utility-related applications.

Module 1 [10L]

Introduction:

Need for power conversion; Power electronic converters: classifications and scope.

Power Semiconductor Devices:

Basic structure & switching characteristics of power diodes, SCR, TRIAC & GTO, V-I characteristics and applications. Two transistor model of SCR, switching characteristics of SCR, Gate Triggering methods of SCR - R, RC, and UJT firing circuits for SCR, series and parallel operation of SCR, Need for snubber circuits, di/dt & dv/dt protection, Different commutation techniques of SCR.

Introduction to Power transistor, MOSFET, IGBT - Ratings, static and dynamic characteristics.

Gate drivers and switching circuits, snubbers, cooling and heatsinks.

Module 2[12L]

Phase controlled converters:

Input and output characteristics of common rectifier topologies: Single-phase half-wave and full-wave controlled rectifiers with R, RL and RLE load. Effect of Free-wheel diode. Semiconverters with R, RL and RLE load. Three-phase half-wave and full-wave controlled and uncontrolled rectifiers with R, RL load (effects of continuous and discontinuous current on converters), Effect of Free-wheel diode, Power quality aspects in converters, Effect of source inductance in controlled rectifier and loss of voltage due to commutation, Introduction to 1-phase dual converter operation and three phase dual converter.

Selection of devices and its specifications.

HOD, EE

DC Choppers:

Classification & operation of choppers (A, B, C, D, E), Control strategies, Buck, Boost and Buck-Boost converters: circuit configuration and analysis, Multiphase chopper.

Module 3[10L]

Inverters:

Definition and classification of inverters: VSI and CSI, SPWM, Brief idea of Resonant Pulse converter.

Principle of operation of 1-phase VSI and 3-phase VSI (120°, 180°) modes.

PWM inverters.

Series and parallel connections of inverters: Basic series inverter, Modified series Inverter, 1-phase parallel inverter operation (without feedback diode).

Multilevel inverters.

Power quality aspects of inverters, Improvement of power quality.

Module 4[8L]

AC-AC direct converter:

Principle of on-off voltage regulator and phase controlled voltage regulator, Operation of 1-phase controlled voltage regulator with R, RL loads.

Principle of operation of cycloconverters, circulating and non-circulating mode of operation single phase to single phase cycloconverters, three phase to three phase cycloconverters.

Introduction to matrix converter.

Applications:

Speed control of AC and DC motors, HVDC transmission, Static circuit breaker, SMPS, UPS, Static VAR compensators, FACTS - shunt and series compensators.

HOD, EE

Text Books:

1. Power Electronics, Mohan, Undeland & Robbins, Wiley India.
2. Power Electronics, M.H. Rashid, PHI, 3rd Edition.
3. Power Electronics, M.D Singh and K.B. Khanchandani, Tata Mc Graw Hill, 2015.
4. Power Electronics, P.S. Bimbhra, Khanna Publishers, 2012.
5. Power Electronics, Dr. P.C Sen, Mc Graw Hill Education, 1st Edition.

Reference Text Books:

1. Modern Power Electronics and AC Drives, B.K Bose, Prentice Hall.
2. Element of Power Electronics, Phillip T Krien, Oxford, 2007.
3. Analysis of Thyristor power conditioned motor, S.K. Pillai, University Press.
4. Power Electronics: Principles and applications, J.M. Jacob, Thomson.

CONTROL SYSTEM
CODE: ELEC3203
CONTACT: 3L+1T

COURSE OUTCOMES OF CONTROL SYSTEMS

Students will be able to

- Know the fundamental concepts of Control systems and mathematical modeling of the system
- Analyze time and frequency response of the system
- Understand the concept of stability and examine it by various approaches
- Acquire knowledge about determination and improvement of system performance
- Design and realize systems using state variable modeling technique

Module -I

Introduction to control systems: Introduction of automatic control, Classification of control systems, open loop and closed loop systems. Examples of control systems. Properties of Control Systems, Elementary concepts of sensitivity and robustness, concepts of non minimum phase systems and time delay systems. [2L]

Representation of Systems: Block diagram representation of control systems. Block diagram algebra. Block diagram reduction and signal flow graph. Mason's gain formula. [4L]

Control system components: Potentiometer, Tacho-generator, Synchro and resolver, DC and AC servomotor, Actuators, Gyroscope. [4L]

Module -II

Time domain analysis: Review of transient & steady state response of first and second order systems. Concept of undamped natural frequency, damping, overshoot, rise time, peak time and settling time. Effects of Poles and Zeros on transient response. Steady-state and transient errors, concept of system types and error constants. [5L]

Stability Analysis: BIBO stability**,** stability by pole location, Routh-Hurwitz criteria and applications, Root locus techniques, construction of Root Loci. [7L]

Module -III

Frequency domain analysis: Review of frequency response of first and second order systems. Frequency Domain Specifications. Bode plot and Nichols chart. Polar plots. Nyquist criterion, Stability margins. Comparison of absolute and relative stability. [10L]

Module -IV

Design of Control System: Control actions: Proportional, integral, derivative actions and their combinations. Design of compensators. Lead, Lag ,Lead- Lag and Lag-Lead compensators. [4L]
State Variable Analysis: State variable formulation of control systems, Canonical forms of SV equations, diagonalization. Introduction to Controllability and Observability. Linear state variable feedback controllers, the pole placement problem. Linear system design by state variable feedback. [6L]

Total: 41L

HOD, EE

Text Books:

1. Control Systems: Principles and Design, M Gopal, TMH
2. Modern Control Engineering, Ogata;Katsuhiko, PHI
3. Automatic Control Systems, B.C. Kuo & F. Golnaraghi, 8th Edition, PHI
4. Control system Engineering: I.J. Nagrath & M. Gopal, New Age International.

Reference books:

1. Digital Control & State Variable Methods: M. Gopal, 2nd Edition, TMH
2. Control system Engineering, Ananda Natarajan , P. Ramesh Babu, Scitech
3. Control System Engineering: D. Roy Chowdhuri, PHI

Microprocessor and Microcontroller (ELEC3204) (3 + 0 + 0)

Course Outcome:

After completing the course, the students will be able to

1. interface both read/write and read-only memories and Input & output devices to microprocessor.
2. write programs in assembly level language in Personal Computer environment, to convert it into .HEX file and download the .HEX file to Read/Write memory of a microprocessor based system for execution.
3. have an idea on microcontrollers / embedded systems
4. Develop the real time systems related to Electrical Engineering

<u>Microprocessor (8085)</u>

Module -I

1. Introduction (1L)
2. Architecture of 8085, Programming model and Instruction set (2L)
3. Timing Diagrams and execution of instruction (1L)
4. How to write simple programs (addition/subtraction, delay routine etc.) (1L)
5. Interfacing of Memory Device (ROM & R/WM) (2L)
6. Interfacing of IO devices, Keyboard, LED, 7-segment display, ADC, DAC, matrix keyboard (5L)

[12L]

Module -II

7. Generation of different waveforms (1L)
8. Programs of higher level and conversion of codes (2L)
9. Interrupts –(software and hardware) and realisation with examples (3L)
10. Interfacing of standard I/O devices – 8255A, 8253/54, concept of serial communication (3L)

[9L]

<u>Microcontroller (8051)</u>

Module - III

1. Introduction
2. Architecture of 8051, facility provided thru pins and concepts of I/O ports, Power-on-reset, Oscillator circuit
3. Memory organization: detailing of internal RAM, SFRs
4. Instruction set, Assembly level Programming concept and simple programs
5. Timers and counters and its different modes
6. Simple programs using timer-counter
7. Interrupts and its priority
8. Serial Communication **[11L]**

Module - IV

9. Programming of Microcontroller in C Language
10. Interfacing of Keyboard, LEDs , 7- segment display, LCD
11. Interfacing of ADC and DAC and sensors,
12. Interfacing of relays, opto-coupler, DC Motor, stepper motor
13. Interfacing of real time clock
14. Advanced serial data transfer protocols: I2C, SPI **[7L]**

PIC Microcontroller

Inrtoduction and basic features **[1L]**

Text Books:

1. Microprocessor Architecture, Programming and Applications with 8085 by R. S. Gaonkar, Penram Pub.
2. The 8051 Microcontroller Based Embedded Systems by Manish K Pate, McGrawHill Pub.
3. 8051Microcontroller and Embedded Systems by Muhammad Ali Mazidi, Janice Mazidi, Janice Gillispie Mazidi .

HOD, EE

DIGITAL SIGNAL PROCESSING
CODE: ELEC3231
CONTACT: 3L

COURSE OUTCOMES OF DIGITAL SIGNAL PROCESSING

Students will be able to

- Develop a clear conception about discrete time signals
- Understand the concept of convolution sum and its properties
- Realize the fundamentals of various transformation techniques
- Compute discrete Fourier Transform by various algorithms
- Design FIR and IIR filters
- Acquire elementary knowledge about digital signal processors

Module-I

Discrete-time signals: Review of concepts of sampling and discrete time signals. Sequences-periodic, energy, power, sample, step, ramp and complex exponentials. Arithmetic operations on sequences. Concept of convolution, graphical, analytical and overlap-add methods to compute convolution. [6]

LTI systems: Definition, difference-equation representation, impulse response. Properties of convolution with physical interpretations-interconnection of LTI systems. [3]

Module-II

z-transform: Review of z-transform and its properties, Application of z-transform. Concepts of z-transfer function. Stability and causality conditions for LTI systems. Recursive and non recursive systems, FIR and IIR systems. [5]

Transformation techniques: Continuous-time to discrete-time transformation: Mapping using impulse invariant transformation, bilinear transformation, approximation of derivative and matched z-transformation. [5]

Module-III

Discrete Fourier Transform: Introduction to discrete-time Fourier transform (DTFT)**.** Concepts of discrete Fourier transform (DFT) and inverse discrete Fourier transform (IDFT), properties of DFT. Computational burden of DFT, DFT/IDFT matrices, multiplication of DFTs. Concepts of circular convolution and its computation. [6]

Fast Fourier Transform: Importance of Fast Fourier Transform (FFT)**,** Implementation- Radix-2 algorithm, decimation-in-time and decimation-in-frequency algorithms, concepts of Butterflies, signal flow graphs. Comparison of computational load of DFT and FFT. [4]

Module-IV

Filter Design: Basic concepts of IIR and FIR filters, difference equations, design of Butterworth IIR filters using impulse invariant and bilinear transforms, design of linear phase FIR filters, rectangular window function, circular complex convolution integral, Gibbs phenomenon. Concepts of Hamming, Hanning and Blackman window. [8]

Digital Signal Processor: Elementary ideas of the architecture and important instruction sets of TMS320C 5416/6713 processor, development of small programs in Assembly Language. [2]

Total= 39L

HOD, EE

TEXT BOOKS:

1. Digital Signal Processing,Principles, Algorithms and Applications, J.G.Proakis & D.G.Manolakis, Pearson
2. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co.
3. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
4. Digital Signal processing – T.K. Rawat, Oxford

REFERENCE BOOKS:

1. Digital Signal Processing, Chen, OUP
2. Digital Signal Processing, Johnson, PHI
3. Digital Signal Processing using MATLAB, Ingle, Vikas.
4. Digital Signal Processing, Ifeachor, Pearson Education.

Electrical Machine Dynamics

CODE: ELEC 3232 **CONTACT: 3L**

The subject helps the student to become familiarized with modern machines which are to be applied in practical field and to design and development for the research skill and find solution of real problems.

MODULE-I

Generalized theory of electric machines:

The Primitive machine, Voltage equations of the Primitive machine. Invariance of power. Transformation from a displaced brush axis, Transformation from three phases to two phases, Transformation from rotating axes to stationary axes. Physical concepts of Park's transformations. Transformed impedance matrix. Electrical torque. Restriction of the generalized theory of electrical machines. [12]

MODULE-II

Direct Current machine dynamics:

Steady state analysis, and transient analysis of D.C machines. Transfer functions of D.C machines. Electrical braking of D.C motors. Parallel operation of D.C generators. [8]

MODULE-III

Synchronous Machine Dynamics:

Basic synchronous machine parameters. Behavior of the machine under certain short circuit condition, short circuit oscillogram. Transient analysis of synchronous machine. Transient torque. Sudden reactive loading and unloading. Steady state and transient Power angle Characteristic. Large angular oscillation. Synchronous machine Dynamics. Electrical braking of synchronous motor. . [12]

MODULE-IV

Induction Machine Dynamics:

Induction machine dynamics during starting and braking. Acceleration time, Induction machine dynamics during normal operation, Operation on unbalanced supply voltage. Slot harmonics. Harmonic effects on Induction motor, Harmonic equivalent circuit and harmonic torque. [8]

Text Books :	Reference Books :
1. Generalized Theory of Electrical Machines by Dr. P.S. Bimbhra 2. Electrical Machinery by S.K.Sen 3. Electric motor drives, modeling, analysis and control, R. Krishnan 4 Dynamic Simulation of Electric Machinery using MATLAB by C. Ong, 5 Analysis of Electric Machinery and Drive Systems by P.C. Krause, Oleg Wasynczuk, Scott D. Sudhoff 6. Electromechanical Motion Device by P.C. krause, O.Wasynczuk	1. Modern power electronics and AC drives, B.K. Bose 2. Electrical Machinery, A.E. Fitzgereld, C. Kingslay and S.D. Uman

HOD, EE

POWER SYSTEM-II Lab
Code: ELEC3211
Contact: 3P

1. Polarity, ratio and magnetization characteristics test on CT and PT
2. To Study & Testing of ON-delay relay and OFF-delay relay
3. To Study the Inverse characteristics of a Under-Voltage relay
4. To Study the Inverse characteristics of Earth Fault relay
5. To Study the Inverse characteristics of Over-Current relay
6. To Study the Inverse characteristics of Directional Over-Current relay
7. To Study Transformer Protection using Electro-mechanical Type Differential relay
8. To study Short Circuit Analysis using Network Analyzer
9. To Study the Performance of Over-Current Relay using ETAP software simulation.
10. To Study the Performance of Under-Voltage Relay using ETAP software simulation.
11. To Study the Performance of Differential Relay for Transformer Protection using ETAP software simulation.
12. To Study the Load Flow analysis by Gauss-Seidel & Newton-Raphson method using ETAP or MATLAB software simulation

HOD, EE

POWER ELECTRONICS LAB
ELEC3212
Contact: 3P

List of Experiments:

1. Study of the characteristics of an SCR.
2. Study of the characteristics of a TRIAC.
3. Study of different triggering circuits of an SCR
4. Study of the operation of a single phase full controlled bridge converter with R and R-L load.
5. Study of performance of single phase half controlled symmetrical and asymmetrical bridge converters.
6. Study of performance of step down chopper with R and R-L load.
7. Study of performance of single phase controlled converter with and without source inductance (Simulation).
8. Study of performance of step up and step down chopper with MOSFET, IGBT and GTO as switch (Simulation).
9. Study of performance of single phase half controlled symmetrical and asymmetrical bridge converter (Simulation).
10. Study of performance of three phase controlled converter with R & R-L load (Simulation).
11. Study of performance of PWM bridge inverter using MOSFET as switch with R and R-L load (Simulation).
12. Study of performance of three phase AC controller with R and R-L load (Simulation).
13. Study of performance of a Dual converter (Simulation).
14. Study of performance of a Cycloconverter (Simulation).

HOD, EE

CONTROL SYSTEM LABORATORY
CODE: ELEC3213
CONTACT: 3P

1. Familiarization with MATLAB control system tool box, MATLAB Simulink tool box
2. Simulation of Step response and Impulse response for type-0, type-1 & Type-2 system with unity feedback using MATLAB.
3. Determination of Root locus, Bode plot, Nyquist plot using MATLAB control system tool box and different control system specifications from the plot.
4. Determination of approximate transfer functions from the Bode plot.
5. Study of P, PI, PD and PID control action for first and second order system using Z-N method.
6. Tuning of P, PI, PD and PID controllers for higher order plants with and without dead time.
7. Design of Lead and Lag compensators.
8. Evaluation of steady state error, rise time, setting time, percentage peak overshoot, gain margin, phase margin etc. with incorporation of Lead and Lag compensators.
9. Design of linear state feedback controllers for a system using MATLAB.

HOD, EE

Department of Electrical Engineering
Microprocessor and Microcontroller Lab (ELEC 3214)
Contact Hours: (0+0+3)

LIST OF EXPERIMENTS

1. a) Familiarization with Microprocessor kit
    i) Starting and ending address of R/W Memory
    ii) To write a program in assembly level consulting the Hex table and address generation
    iii) To enter a program, how to run and how to verify the result in a Microprocessor kit
    iv) To edit a program in PC, how to assemble it, how to link it to generate a .hex file and how to download the .hex file to the kit using serial com port and execute it etc. etc.

   b) To write a program (WAP) in assembly level to add two numbers, taken in registers and store the result in a memory location.

Write a program (WAP) in assembly level

2. a) to add two numbers stored in two consecutive memory locations and store the sum in next memory location.
   b) to add ten numbers stored in consecutive memory locations and store the sum in a memory location (assuming the result will not produce any carry).
3. a) to store the incremental data in consecutive memory locations.
   b) to copy the block of data from one memory area to another memory area
   c) to copy and paste the block of data from one memory area to another memory area
4. a) to find the largest / smallest number in a block of data.
   b) to arrange the block data in ascending / descending order.
5. a) to unpack a BCD number and pack an unpacked BCD number.
   b) Addition of two BCD numbers.
6. a) to convert a BCD number to the corresponding Binary number.
   b) to convert a binary number to the corresponding BCD number.
7. a) to convert a BCD code to a common anode 7-segment code.
   b) to convert a binary code to the corresponding ASCII code.
8. a) to configure the ports of 8255 Programmable Peripheral Interface (PPI)
   b) to interface a 7 segment LED display, to blink the LEDs of a 7-segment for half second ‘on’ and half second ‘off’
9. to display 0 thru 9 on 7-segment display for half second display and half second off.
10. to generate different waveforms (square, saw-tooth, triangle and sine) using DAC0808 interfacing.
11. to interface an ADC0808/0804 with microprocessor/microcontroller and take a digital data in corresponding to an analog data and store it in a memory.
12. to interface a 16X2 LCD display with 8051 microcontroller.
13. 4X4 keyboard interfacing with 8051 microcontroller.
14. Familiarization with integrated development environment (IDE) of PIC microcontroller, programming and running a sample program to blink an LED etc.

HOD, EE

Course Name: MICROELECTRONICS & ANALOG VLSI DESIGN					
Course Code : ECEN3103					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Outcomes:
After completing the course the student will be able to:

1. Understand the fundamentals of MOSFET Device Physics.
2. Correlate the fundamental understanding with the evolving VLSI Design Trends and Challenges.
3. Understand the IC Fabrication Process Flow leading to the practical realization of the scaled MOSFETs.
4. Analyze analog VLSI sub-circuits and design them namely, current mirrors, voltage, and current references.
5. Design circuits of practical importance e.g., amplifiers.
6. Apply the knowledge of analog sampled data circuits to synthesize practical circuits such as switched- capacitor filters.

Module I: Introduction and the MOS Transistor: [8L]

Unit1: Evolution of Microelectronics, Moore's Law, Process Node Definition, Evolution of Process Technology, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), ITRS, VLSI Design Trend and Challenges.

Unit2: Knowledge about MOS, Structure and Principle of operation of enhancement-mode MOS transistor, MOS-Characteristics, MOS Capacitors, Short Channel MOS, NMOS vs PMOS.

Module II: Fabrication Flow: [10L]

Unit1: IC Process Flow, clean environment, Wafer Growth and Preparation, CVD Techniques, Epitaxy, Oxidation (Dry and Wet), Photo Lithography: Contact, Proximity, Projection, Photo Resist, Etching (Wet and Dry), Diffusion, Ion Implantation, Metallization and interconnects. VLSI Process Integration. Assembly & Packaging of VLSI devices.

Unit2: CMOS Fabrication flow step by step using self aligned techniques (N-well Process), CMOS Fabrication Process Overview and Structure for N-Well, P-Well, Twin Tub, Lamda and Micron rules, SOI, FINFET. Yield loss & Reliability analysis in VLSI design.

Module III: Analog VLSI Sub-circuits: [10L]

Analog VLSI Design Steps, Basic Building Blocks of Analog VLSI Chips, large signal and small signal analysis and equivalent circuit model, small signal parameters for low frequency and high frequency model, MOS Switch, MOS Diode, Active Load/Resistors, Voltage Dividers, Current Mirror, CMOS Current Mirror & Sink (Cascode), CMOS Voltage Reference, CMOS Bandgap Reference (Basic Circuit Only).

Module IV: Analog VLSI Circuits: [10L]

Unit1: Common-Source, Common-Drain and Common-Gate single stage amplifiers, Differential Amplifier: Common Mode, Differential Mode, Transfer Characteristic Curves, CMRR, Differential Amplifier with Active Load.

Unit2: CMOS OPAMP, Switched Capacitor Filter .

Text Book:

1. VLSI Technology 2ND Edition, Author: Sze, S.M.; MCGRAW HILL COMPANIES .
2. CMOS Analog Circuit Design (second edition) Phillip E. Allen and Douglas R. Holberg (Oxford) .
3. Microelectronic Circuits- A.S. Sedra & K.C.Smith- Oxford International student edition.

References:

4. The MOS Transistor (second edition) Yannis Tsividi s (Oxford) .
5. Design of Analog CMOS Integrated Circuit, B. Razavi, Mc, Graw Hill .

HOD, ECE Department
Heritage Institute of Technology
Kolklata

Course Name: MICROELECTRONICS & ANALOG VLSI DESIGN LABORATORY					
Course Code : ECEN3113					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

After completing the following experiments, students will be able to:

1 Understand Basics of microelectronics and VLSI design
2. Categorize various types of MOS, IC manufacturing Process - the steps
3. Analyze Analogue VLSI circuits – the intricacies
4. Design important Circuits like OP AMP and their analysis

List of Experiments:

Sub Micron and Deep Sub Micron Technology based Experiments:

1. Introduction to Tanner Design & Layout Tools and SPICE Analysis:
    a. Familiarity with Tanner CAD Tools (S-Edit, W-Edit, L-Edit, DRC, LVS)
    b. Familiarity with T-Spice
    c. NMOS, PMOS VI Characteristics
    d. Transient analysis of CMOS Inverter Circuit
2. Tanner Tool Based Analog Experiments:
    a. MOS as Resistors, Current Source, Sink, Current Mirror
    b. DC, Transient and AC analysis of Single Stage Amplifier
    c. Circuit Analysis of Differential Amplifier

HOD, ECE Department
Heritage Institute of Technology
Kolklata

Course Name: MICROPROCESSORS, MICROCONTROLLERS & SYSTEMS					
Course Code : ECEN3104					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:
After completing the course the student will be able to:

1. Understand the basics of microprocessor and microcontroller with the help of previous knowledge of Digital Electronics.
2. Develop the concepts of MPU, timing and control signals I/O devices, types of BUS, etc that form the background of this course.
3. Develop the ALP for given problems with flowchart and learn about the interrupts stack and subroutine.
4. Learn and apply the architecture of 8086 family.
5. Analyze and solve memory interfacing and I/O interfacing problems and develop idea about several peripheral devices.
6. Analyze the architecture of microcontroller 8051 with respect to I/I ports, Memory, Counters and Timers etc.

Module I: Introduction [4L]
MPU, I/O devices, Memory, Timing and Control Signals, Bussed Architecture, Tristate logic, Latch, Address Bus, Data Bus and Control Bus.

Module II: Microprocessor

8085 [10L]
Intel 8085 Microprocessor Architecture – Signals – Addressing modes – Instruction classification Instruction set—Timing diagram – Memory Mapped and Peripheral I/O- ALP format – Programming 8085 – 8-bit and 16-bit Operation including stack-subroutine – Interrupt structure of 8085 microprocessor, Processing of vectored and Non-vectored interrupts, Latency time and Response time; Handling multiple interrupts.

8086 [8L]
Intel 8086 microprocessor - Architecture - Signals- Segmented Memory – EU and BIU - Instruction Set-Addressing Modes – Minimum and Maximum Modes of Operation- Even and Odd Memory Bank- Basics of Assembly Language Programming.

Module III: I/O Interfacing [8L]
Memory interfacing and I/O interfacing with 8085– PPI 8255 – Programmable keyboard display –Interface 8279 – Programmable interrupt controller 8259 –Programmable DMA controller 8257 –USART 8251 –Programmable interval timer 8253. ADC & DAC Interfacing.

Module IV: Microcontroller & Systems

HOD, ECE Department
Heritage Institute of Technology
Kolkata

8051 [6L]

Architecture of 8051 Microcontroller – Signals – I/O ports – Memory – Counters and Timers – Serial Data I/O – Interrupts. Interfacing - Keyboard, LCD, Stepper Motor Control.

Text Books:

1. Microprocessor Architecture, Programming & Application with 8085-R. Gaonkar (Penram International).
2. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, Mc Grawhill Education.
3. The 8051 Microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (Pearson).
4. Microprocessor and Programmed Logic by Kenneth L Short.2nd Edition, Pearson.

Reference Books:

1. Microprocessors and microcontrollers -N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxford University Press
2. An Introduction to Microprocessor and Applications –Krishna Kant (Macmillan).
3. Fundamentals of Microprocessor and Microcontrollers by B. Ram. Dhanpat Rai Publications
4. Microprocessors and Microcontrollers by A. Nagoorkani Mc Grawhill Education.

HOD, ECE Department
Heritage Institute of Technology
Kolklata

<table>
<tr><td colspan="6">Course Name: MICROPROCESSORS, MICROCONTROLLERS & SYSTEMS LABORATORY</td></tr>
<tr><td colspan="6">Course Code : ECEN3114</td></tr>
<tr><td rowspan="2">Contact Hours per week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>3</td><td>2</td></tr>
</table>

Course outcomes:

After completing the following experiments, students will be able to:

1. Select proper instructions and build different assembly language program for 8085 microprocessor

2. Understand the assembly language programming concept of microprocessor

3. Design the interfacing of input/output devices with 8085 microprocessor using partial and absolute address decoding

4. Build assembly language program to control input/output devices for various applications

5. Analyze the processing of analog signal and generation of various analog signals using interfacing circuit

6. Realize the programming concept of hardware interrupts in 8085 microprocessor

List of Experiments:

1. Write an Assembly Language Program (ALP) using 8085 to

(a) Store a certain data byte in memory location.

(b) Exchange the content of memory locations.

(c) Find the 2's complement of the number and store it in a certain memory location.

(d) Find the square of first nine natural numbers from look up table.

(e) Add two 8-bit numbers stored in consecutive memory locations.

2. Write an ALP using 8085 to multiply two 8-bit numbers by shift and add method.

3. Write an ALP using 8085 to convert HEX Number to ASCII number.

4. Write an ALP using 8085 to arrange a series of numbers in (a) ascending order (b) descending order.

5. Write an ALP using 8085 to generate a Fibonacci series.

6. Write an ALP using 8085 to pack and unpack a BCD number.

7. Interfacing of peripheral devices with the 8085 microprocessor using 8255 PPI.

(a) To perform the addition of two hex numbers and display the result.

(b) To obtain the complement of a hex number and display the result.

(c) To scroll a bit using a delay subroutine.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

8. Write an ALP to convert an analog voltage (0-5 Volts) using the 0809 A/D Converter and display the corresponding digital value suitably using 8085 microprocessor and with 8255 PPI.

9. Write an ALP to display a data in the 7-segment display using 8085 and 8255 PPI.

10. Write an ALP to:

(a) Perform the addition of two 8-bit numbers using 8051 microcontroller.

(b) Swap the nibbles of an 8-bit data (without using the SWAP instruction) using the 8051 microcontroller.

11. One novel experiment beyond the scope of the syllabus.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name: DIGITAL COMMUNICATION					
Course Code : ECEN3105					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Apply the concepts of various techniques for analog signal transmission and modulation from the knowledge gathered earlier.
2. List the functions of different components of a digital communication system and understand Pulse code Modulation System.
3. Identify some mathematical concepts like probability theory and random process and design the source coder and channel coder blocks of the digital communication system using these concepts.
4. Analyze error performance of a digital communication system in presence of noise and other interferences and apply this knowledge to solve numerical problems.
5. Understand performance of Digital modulation and demodulation techniques in various transmission environments and concept of OFDM and Spread Spectrum Communication system.
6. Design a digital communication system and evaluate the performance of the system in presence of noise.

Module I: [8L]

Elements of Digital Communication System, Pulse code modulation : Sampling, Quantization, quantization noise, linear and non linear quantization, Companding, A-Law and μ -law companding, Source encoding, Differential pulse code modulation, linear predictive coders, Delta modulation, Adaptive delta modulation.

Module II: [13L]

Probability Theory and Random Processes: Concept of probability, Conditional probability, communication example, joint probability, statistical independence, random variable-continuous and discrete, cumulative distribution function, Probability Distribution Function – Gaussian and Rayleigh, mean, variance, random process, stationary and ergodic processes, correlation coefficient, covariance, autocorrelation function and its properties, power spectral density.

Different type of line coding : Properties of line coding – Polar/Unipolar/Bipolar NRZ and RZ, Manchester, Differential encoding and their PSDs, pulse shaping, Inter Symbol Interference (ISI), Eye pattern, Nyquist criterion for zero ISI, equalizer, zero forcing equalizer, Regenerative repeater, Bit synchronization, Frame synchronization.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module III: [8L]

Signal Vector Representation: Analogy between signal and vector, distinguishability of signal, orthogonal and orthonormal basis functions, orthogonal signal space, message point, signal constellation, geometric interpretation of signals, likelihood functions, Schwartz inequality.

Baseband transmission: Baseband signal receiver, integrate and dump type filter, probability of error calculations, optimum filters, coherent reception, matched filter and its transfer function, Probability of error of matched filter, Concept of error function, complementary error function and Q function.

Module IV: [9L]

Digital Modulation Techniques: Types of Digital Modulation, coherent and non-coherent Binary Modulation Techniques, Geometrical representation, generation, detection, error probability and power spectra of basic digital carrier modulation techniques: ASK, PSK and FSK. Concept of QAM and M-ary Communication, M-ary phase shift keying, average probability of symbol error for coherent M-ary PSK, power spectra of MPSK, Quadrature Phase Shift Keying (QPSK), Generation, detection, error probability and power spectra of QPSK signal, Offset Quadrature Phase shift Queuing (OQPSK), Minimum Shift Keying (MSK), signal constellation of MSK waveforms, error probability of MSK signal, Gaussian Minimum Shift Keying: GMSK, Basic Concept of OFDM and Spread Spectrum Modulation

HOD, ECE Department
Heritage Institute of Technology
Kolkata

TEXT BOOKS:

1. Digital Communications, S. Haykin, Wiley India.
2. Principles of Communication Systems, H. Taub and D.L.Schilling, TMH Publishing Co.
3. Digital Communications, J.G.Proakis, TMH Publishing Co.
4. B.P. Lathi, Modern Digital and Analog Communication System, Oxford University Press.
5. Electronic Communications Systems, Wayne Tomasi, Pearson Education.

REFERENCE BOOKS:

1. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
2. Digital Communication, A. Bhattacharya, TMH Publishing Co.
3. Wireless Communication and Networks : 3G and Beyond, I. Saha Misra, TMH Education.
4. L.W. Couch II, Modern Communication System, Prentice Hall India.
5. Roden, Analog & Digital Communication Systems, 5e, SPD
6. Communication Systems (Analog and Digital), Sanjay Sharma, Katson Books

Course Name: Digital Communication Laboratory					
Course Code : ECEN3115					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

After completing the following experiments, students will be able to:

1. Understand, design and implement PN sequences with shift registers, Pulse Amplitude Modulators and demodulators etc.

2. Describe Line codes like polar/ uni polar NRZ, RZ.

3. Analyze various digital modulation and demodulation schemes.

4. Acquire an insight into Digital Communication systems in totality

List of Experiments:

1. Design and implementation of 7-length PN sequences using shift register.
2. Implementation and study of Pulse Amplitude Modulation and demodulation.
3. Study of Pulse Width Modulation and Demodulation
4. Implementation and study of Line Codes : polar/unipolar NRZ , RZ.
5. Implementation and Study of BASK Modulator.
6. Implementation and Study of BASK Demodulator
7. Implementation and Study of BFSK Modulator
8. Implementation and Study of BFSK Demodulator
9. Implementation and Study of BPSK modulator
10. Experiment beyond curriculum.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

ECE Department B.Tech., 3rd. Year, 2nd Semester

Course Name: DIGITAL VLSI DESIGN					
Course Code : ECEN3201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:
After completing the course the student will be able to:

Students will be able to relate to different MOS structures and functions in order to apply the knowledge in building CMOS circuits
2. Students can classify between VLSI Design Cycle, Style and Methodology.
3. Students will be able to determine logic and performance of CMOS combinational and sequential logic.
4. Students will be able to construct physical layout design and stick diagram of digital gates.
5. Students will be able to make use of various synthesis flow and HDL modeling in ASIC Semi custom design.
6. Students will be able to interpret Si testing and debug related algorithms and fault modeling.

Module I: VLSI Design Flow and CMOS Combinational Circuits: [14L]

Unit1: VLSI Design Cycle . Short channel threshold voltage. Design Heirarchy, Layers of Abstraction, Y-Chart, Design Styles, Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX.

Unit 2: Switching Characteristics of MOS Transistors: Capacitive Effects, Process Characteristic Time Constant, propagation delay models, switching delay in logic circuits. High field effects.

Unit 3 : Inverter Characteristics and CMOS Combinational Logic : MOS inverters, CMOS inverter, DC characteristics, Noise Margin and Switching point, switching characteristics, dynamic power dissipation issues. Propagation delay & Delay equation. Static CMOS Logic gate design, pseudo-nMOS gates, pass transistor logic, Logical effort, transmission gate, TG logic, basic idea of dynamic and domino logic.

Module II: CMOS Sequential Circuits and Physical Design[10L]

Unit 1 : Bistability principle, SR Latch circuit, clocked JK Latch/ Master-Slave JK, CMOS D-latch & Edge triggered flip-flop, basic idea of DRAM and SRAM.

Unit 2 : CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm .

Module III: Synthesis and HDL [8L]

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Unit 1 : Synthesis – High level, Logic level, Brief ideas on partitioning, floorplanning, placement, routing and compaction

Unit 2 : Why HDL ? Frontend Design Flow using HDL (Behavioral, RTL and Gate Level), Verilog Coding, Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed, FSM Example: Mealy Machine and Moore Machine.

Module IV:Test Methodology of VLSI Circuits: [6L]

Unit 1: Si Testing: Why Testing, Challenge of Si-Testing, Manufacturing Defects, Die (Inter and Intra) Variation, Yield, DPM, Logical Fault Modelling: Stuck at Faults (D-Algorithm), Bridging Fault, Transistor Stuck open/Stuck Short, ATPG, DFT, Scan Design, BIST.

HOD, ECE Department
Heritage Institute of Technology
Kolklata

Text Books:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000 .
2. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011. Fundamental of VLSI Devices – Y. Taur & T.H. Ning- Cambridge University Press.

Reference Books:

3. CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006 .
4. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
5. VLSI Design and EDA TOOLS, Author: Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, SCITECH PUBLICATIONS (India) Pvt. Ltd., 2011.

Course Name: DIGITAL VLSI DESIGN LABORATORY					
Course Code : ECEN3211					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

After completing the following experiments, students will be able to:

1. Understand Basics of designing logic gates, LUT etc.
2. Categorize CMOS sequential circuits, Stick diagram etc. and their implications
3. List the Usages of HDL, state machine models
4. Gain insight into Testing of ICs, different techniques.

List of Experiments:

1. Sub Micron and Deep Sub Micron Technology based Experiments:
   Backend Design flow using Tanner Design & Layout Tools and SPICE Analysis
   a. Transient analysis of CMOS Inverter Circuit
   b. DC & Parametric analysis of CMOS Inverter
   c. Layout Design and Verification of CMOS Inverter Using Tanner Tools
   d. Implementation of Various Logic Gates
   e. Implementation of Various Sequential Gates

2. Introduction to XILINX-Vivado Simulator, Verilog Coding and Test Bench Simulation
   a. Logic Design and Verification of Digital Gates, Mux, Encoder, Decoder
   b. Logic Design and Verification of a 15 Bit Ripple-Carry Adder
   c. Logic Design and Verification of Sequential Gates: D-Latch, Flop
   d. Logic Design and Verification of a Finite State Machine

3. FPGA Programming Flow using XILINX Hardware Kits: Implementing and verifying many of above experiments in FPGA hardware Kits.

HOD, ECE Department
Heritage Institute of Technology
Kolklata

Course Name : DIGITAL SIGNAL PROCESSING & APPLICATIONS					
Course Code : ECEN3202					
Contact Hours per	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:

After completing this course, the students will be able to:

1 Use concepts of trigonometry, complex algebra, Fourier transform, z-transform to analyze the operations on signals and acquire knowledge about Systems

2 Apply computational tools to evaluate fourier transform on a digital computer , implementation of many signal processing algorithm and designed hardware .

3 Design, implementation, analysis and comparison of digital filters for processing of discrete time signals

4 Application of multirate signal processing for conversion of A/D and D/A and can design multiplexing system for communication.

5 Student can analyze the application of microprocessor with architecture and instruction sets optimized DSP operation.

6 Assess the techniques, skills, and modern engineering tools necessary for analysis of different communication signals and filtering out noise signals in engineering practice. Also develop creative and innovative designs that achieve desired performance criteria within specified objectives and constraints, understand the need for lifelong learning and continuing professional education.

MODULE I: [7L]

Introduction to Discrete time signals and systems:

Concept of discrete-time signal and systems: basic idea regarding sampling and reconstruction of signals, arithmetic operations on sequences, representation of systems, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical methods to compute convolution supported with examples and exercises, properties of convolution, interconnections of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems

Z-Transform:

Definition, mapping between s-plane and z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples and exercises,

HOD, ECE Department
Heritage Institute of Technology
Kolkata

characteristic families of signals along with ROCs, convolution, correlation and multiplication using Z-transform, initial value theorem, Parseval's relation, inverse Z-transform by contour integration, power series & partial-fraction expansions with examples and exercises.

MODULE II: [8L]

Discrete Fourier Transform:

Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT/IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Save and Overlap-Add methods with examples and exercises.

Fast Fourier Transform:

Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithms, signal flow graphs, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises.

MODULE III : [13 L]

Filter Concepts:

Introduction to the concept of Digital Filters, frequency response and filter characteristics, basic concepts of IIR and FIR filters .

IIR Filters:

Introduction to analog filter design: Butterworth and Chebyshev filters design, Transformation techniques: Impulse invariant method and bilinear transformation, Warping effect and prewarping. Design procedure for low pass digital Butterworth and Chebyshev filter design.

FIR Filters:

Linear phase filters: Condition for filter to have linear phase response and its frequency response (Type I, II, III, IV),

Design techniques: Fourier series method, Gibb's phenomenon, Windowing method (Rectangular, Hamming and Hanning window). Comparative advantages & disadvantages of FIR & IIR Filters.

MODULE IV: [8L]

Realization of Digital Filters

Direct form I, Direct Form II, Cascade form structure, Parallel form structure.

Multirate Signal Processing

Introduction: Advantage of Multirate Digital Signal Processing

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Decimation: Time domain characteristic, frequency domain characteristic, aliasing effect and anti-aliasing filter specification.

Interpolation: Time domain characteristic, frequency domain characteristic .

Introduction to Digital Signal Processor
Evaluation of DSP processor, DSP architecture, TMS320C3XX .

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis & D.G.Manolakis, Pearson Ed.
2. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co
3. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
4. Digital Signal Processing, A. Nagoor Kani, TMH Education .
5. Theory and application of digital signal processing- L.R. Rabiner & B. Gold- PHI.
6. Analog & digital Signal Processing- A. Ambardar- Books/Cole Pub.

References:

6. Digital Signal Processing,Tarun Kumar Rawat,Oxford Press
7. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co .
8. Digital Signal Processing; A Hands on Approach, C. Schuler & M.Chugani, TMH Publishing Co.
9. Digital Signal Processing S. Poornachandra & B. Sasikala, MH Education .
10. Digital Signal Processing; Spectral Computation and Filter Design Chi-Tsong Chen, Oxford University Press .
11. Texas Instruments DSP Processor user manuals and application notes.

Course Name: DIGITAL SIGNAL PROCESSING & APPLICATIONS LABORATORY					
Course Code : ECEN3212					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	2

Course Outcomes:

After completing the following experiments, students will be able to:

1. Understand the basics of sampling, convolution etc, Z-transform
2. Identify DFT and FFT and their applications
3. Analyze Filters – IIR and FIR
4. Categorize Digital filters, multirate signal processing etc

Simulation Laboratory using standard Simulator:

1. Convolution of two sequences using graphical methods and using commands-verification of the properties of convolution.
2. Z-transform of various sequences – verification of the properties of Z-transform.
3. Twiddle factors – verification of the properties.
4. DFTs / IDFTs using matrix multiplication and also using commands.
5. Circular convolution of two sequences using graphical methods and using commands, differentiation between linear and circular convolutions.
6. Verifications of the different algorithms associated with filtering of long data sequences and Overlap –add and Overlap-save methods.
7. Butterworth filter design with different set of parameters.
8. Chebyshev filter design with different set of parameters.
9. FIR filter design using rectangular, Hamming and Blackman windows.

Hardware Laboratory using Xilinx FPGA:

1. Writing of small programs in VHDL and downloading onto Xilinx FPGA.
2. Mapping of some DSP algorithms onto FPGA.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name: TELECOMMUNICATION SYSTEMS (PROF ELECTIVE 1)					
Course Code : ECEN3234					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course Outcomes:
After completing the course the student will be able to:

1. Apply the previous knowledge of analog communication to appreciate the contents of this paper.
2. Understand basics of Telecommunications and its entities along with the evolution of different types of exchanges.
3. Identify concepts of Telecommunication like signaling techniques, setting up links etc effectively.
4. Describe working principles and practical applications of FAX, EPABX,ISDN etc effectively.
5. List salient features of EWSD, NGN, ADSL etc.
6. Evaluate performance of a telecom network using the concepts of Traffic Engineering and case studies based on the observation.

Module I: (10L)
Introduction to Telephone and Switching Systems
Evolution of Telecommunication, Components and Examples of Telecommunication Systems, Pulse and Tone Dialing, Telephone Instruments- Rotary Dial and Push Button Types, Electro-mechanical switching – Strowger and Crossbar, Circuit Switching and Packet Switching, Digital Switching Systems- Time Division Time Switch, Time Multiplexed Space Switch, Time Multiplexed Time Switch, Hybrid Switching, TS,ST,STS,TST systems, Architecture of 5ESS systems.

Module II: (8L)
Telecommunication Transmission Lines and Subscriber Loop Systems (8L)
Copper, co-axial and Fiber-Optic cables, Transmission Fridge- Hybrid Circuit for 2-wire to 4-wire conversion and vice versa. PCM Carriers, American and European standards of carrier channels.
BORSCHT Functions, Switching Hierarchy and Routing, Signaling Techniques- In channel and Common Channel Signaling, Signaling System 7 (SS7).
Introduction to Global Telecom Link through Satellite Networks

Module III: (10L)
Stored Program Control
Software architecture, Application Software, Electronic Exchanges, Introduction to Cordless Telephones and Digital PABX.
Introduction to Modems, FAX, Broadband Transmission- ISDN, DSL, ADSL, ISDN, B-ISDN, Introduction to IP Telephony.
INTRODUCTION TO NEW GENERATION OF ELECTRONIC EXCHANGES- EWSD (ELECTRONIC WORLDWIDE SWITCH DIGITAL), NGN (NEXT-GENERATION NETWORK)

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module IV: (8L)
Traffic Engineering
Blocking network, Blocking Probability, Grade of Service, Traffic Load, Erlang-B congestion formula- case studies

Text Books:

a) T. Viswanathan “Telecommunication Switching System and Networks”, PHI
b) J.C Bellamy “Digital Telephony” – Wiley India

Reference Books:

a) O Hersent, D Gurle, J P Petit “ IP Telephony” Pearson
b) J. E Flood “ Telecommunication Switching, Traffic and Networks” Pearson
c) R L Freeman “ Telecommunication System Engineering” Wiley-India
d) A Gokhale “ Introdcution to Telecommunication” – Cengage Learning

Course Name : Communication Techniques					
Course Code: AEIE3101					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [10L]

Analog Communication: Introduction to baseband transmission & modulation (basic concept); elements of communication systems (mention of transmitter, receiver and channel); Origin of noise and its effect, importance of SNR in system design; AM modulator & demodulator, basic principles of non-linear modulation (angle modulation - FM, PM); bandwidth requirements for angle modulated waves, comparison of various analog communication system (AM –FM – PM), VCO and PLL.

Maxwell's equations-interpretation of equations, displacement current, continuing, transmission lines-field distribution of E & H field, concept on transmission of EM wave (mention of lumped & distributed parameters, line parameters, propagation constant, characteristic impedance, wavelength, velocity of propagation, distortion-less line, reflection and transmission co-efficients).

Module II – [9L]

Digital Communication: Bit rate, baud rate; information capacity, Shanon's limit; m-ary encoding, introduction to the different digital modulation techniques - ASK, FSK, PSK, BPSK, QPSK, FSK & QPSK modem, quadrature amplitude modulation (QAM); Delta modulation, adaptive delta modulation (basic concept and applications); Introduction to DPCM and spread spectrum modulation.

Module III – [13L]

Digital Transmission: Sampling theorem, sampling rate, impulse sampling, reconstruction from samples, aliasing; analog pulse modulation - PAM (natural & flat topped sampling), PWM, PPM; basic concept of pulse code modulation, block diagram of PCM; Multiplexing - TDM, FDM.

Concept of quantization & quantization error, uniform quantizer; non-uniform quantizer, conceptual idea of A-law & μ-law companding; encoding, coding efficiency, source, line coding channel coding & properties, NRZ & RZ, AMI, manchester coding PCM, DPCM; baseband pulse transmission, matched filter (its importance and basic concept), error rate due to noise; error control & coding, nyquist criterion for distortion-less base-band binary transmission, concept of eye pattern, signal power in binary digital signals.

Module IV – [8L]

Multiple Access Techniques and Radio Communication: Multiple access techniques, TDMA, FDMA and CDMA in wireless communication systems, advanced mobile phone system (AMPS), global system for mobile communications (GSM), cellular concept and frequency reuse, channel assignment and handoff, Bluetooth, introduction to satellite communication.

References:

1. Simon Haykin, *Communication Systems;* 4th Edition, John Wiley & Sons. 2001.
2. B.P.Lathi, *Modern Analog And Digital Communication systems;* 3/e, Oxford University Press, 2007.
3. H.Taub,D L Schilling ,G Saha , *Principles of Communication;* 3/e,2007.
4. Martin S.Roden, *Analog and Digital Communication System*; 3rd Edition, PHI.
5. G. S. N. Raju, *Electromagnetic Field Theory & Transmission Lines*; Pearson Education.

Course Outcomes:

After the completion of the course students will be able to

1. Distinguish among different analog modulation techniques with their advantages, disadvantages and applications
2. Interpret Maxwell's equations physically and explain wave properties in lossy, lossless and distortion less medium
3. Compare the merits and short comings of the basic digital modulation techniques
4. Apply sampling theorem to sample analog signal properly and Differentiate among pulse modulation & demodulation techniques and signal multiplexing for engineering solutions
5. Describe and determine the performance of coding schemes for the reliable transmission of digital representation of signals & information over the channel and methods to mitigate inter symbol interference
6. Compare modern multiple access schemes, explain the concept of frequency reuse, channel assignment strategies and make use of wireless communication tools

Course Name : Microprocessors- Architechture And Applications					
Course Code: AEIE3102					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I - [12L]

Introduction of microcomputer system.
Introduction to 8 bit Microprocessor: History of microprocessor, 8085A microprocessor internal architecture, buses, 8085 pin description.
Software instruction set, addressing modes and assembly language programming.

Module II - [10L]

Instruction cycle, machine cycle, timing diagrams.
Interrupts: Introduction, interrupt vector table, interrupt service routine, programs using interrupts, DMA operation.
Stack and stack handling, call and subroutine, counter and time delay generation.

Module III - [6L]

Interfacing of memory chip and input / output devices: Absolute and partial address decoding, interfacing of different size of memory chips with 8085A, Memory mapped I/O and I/O mapped I/O, interfacing of input/output devices with 8085A.

Module IV - [12L]

Programmable peripherals and applications: Block diagram, pin description and interfacing of 8255(PPI) with 8085A microprocessor. Interfacing of LEDs, switches, stepper motor, ADC and DAC using 8255.
Block diagram, pin description and interfacing of 8259, 8254 and 8251 USART with 8085A microprocessor.

References:

1. Ramesh S. Gaonkar, *Microprocessor architecture, programming and applications with 8085/8085A*; Wiley eastern Ltd.
2. B. Ram, *Fundamental of Microprocessor and Microcontrollers*; Dhanpat Rai Publications.
3. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, *Microprocessors and Microcontrollers*; Oxford Publications.
4. A. Nagoor Kani, *8085 Microprocessor and its Applications*; Third Edition, TMH Education Pvt. Ltd.

Course outcome:

After the completion of the course the students will be able to:

1. Understand the architecture of 8 bit microprocessor (8085A).
2. Describe the importance and function of each pin of 8085A Microprocessor.
3. Develop the skill in program writing for 8085A microprocessor.
4. Describe different types of memory and I/O interfacing with 8085A microprocessor.
5. Describe the architecture of different types of programmable peripheral devices and their interfacing with 8085A microprocessor.
6. Develop the skill to interface different types of I/O devices with 8085A microprocessor using programmable peripheral device.

Course Name : Industrial Instrumentation					
Course Code: AEIE3103					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [10L]

Measurement of Pressure and Vacuum: Introduction, manometers, diaphragm, capsule, bellows, bourdon tube, pressure switch, differential pressure gauge, dead weight tester; Flapper nozzle assembly, pneumatic relay, pneumatic transmitter - force balance and motion balance system; Electronic Pr / DP transmitters – capacitive, piezoresistive and resonating wire type; installation of pressure measuring instruments with accessories like seals, snubbers, valve manifolds and installation of DP measuring instruments; Mcleod gauge, thermal conductivity gauge, ionization gauge.

Module II – [12L]

Flow rate Measurement: General concepts – Reynolds's number, laminar flow, newtonian & non-newtonian fluids; head type flow meters – orifice, venturi, pitot tube, multiport averaging pitot, flow nozzle; variable area flow meters – glass and metal tube rotameters; electromagnetic flow meters; ultrasonic flow meters; vortex flow meters; positive displacement flow meters; turbine flow meters; Coriolis flow meters; open channel flow measurement - different shapes of weirs and corresponding flow relations, solid flow measurement.

Module III – [8L]

Level Measurement: Sight glass, float and displacers type instruments – gauges and switches, interface level measurement; resistive and capacitive type level instrument; D/P type sensors and boiler drum level measurement; ultrasonic and microwave type level instruments, radioactive level measurement, solid level measurement.

Module IV – [10L]

Temperature Measurement: filled in systems – liquid, gas and vapour, ranges, media, errors, construction details and comparison, classification; bimetal elements, thermostats; RTD – working principle, different wired configuration, characteristics, typical industrial application; thermocouples – working principle, cold junction compensation, different types of thermocouples and their application in industry and laboratory, thermopiles; thermowells, thermistor; total radiation pyrometer, optical pyrometers; hazardous area instrumentation: basic concepts, classification based on site, material and temperature – IEC and North American system; methods of protection – explosion proof, intrinsic safety, zener barrier, purging and pressurization, non-incendiary; IEC equipment protection level (EPL); NEMA and IP codes.

References:

1. B. G. Liptak, *Instrument Engineers Handbook, vol-I and vol-II*; Chilton Book Co. Philadelphia.
2. D. Patranabis, *Principles of industrial Instrumentation*; TMH, New Delhi, 2nd Ed.
3. Eckman, *Industrial Instrumentation*; Wiley Eastern Ltd.
4. D. M. Considine and G. D. Considine (Eds.) *Process Instruments and controls Handbook*; Mc Graw Hill, New York.
5. Ernest O. Doeblin, *Measurement Systems – Application and Design*; Tata-McGraw Hill.
6. K Krishnaswamy, *Industrial Instrumentation*; New Age International.
7. S. K. Singh, *Industrial Instrumentation & Control*; Tata McGraw-Hill.

Course Outcome:

After the completion of the course students will be able to

1. Learn the working principle of measuring devices for pressure and apply their knowledge for selection and installation of proper sensing instruments applicable to the process in hand.
2. Design different flow measuring devices towards the choice of proper sensing instruments required in industry
3. Analyze level measuring devices with necessary accessories for industry and societal needs
4. Demonstrate working knowledge of temperature measuring devices as well as safety practices used in the measurement and control of industrial processes
5. Design electronic instrumentation system for the acquisition of measurement data produced by measuring instruments for flow, level, temperature and pressure
6. Formulates industrial process parameters towards the analysis of process data

Course Name : Control Systems					
Course Code: AEIE3104					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [10L]

Elementary control concept - control system terminology and examples, basic structure of open loop, feedback and feed forward control system; mathematical model of physical system - importance, differential equation representation of physical systems, transfer function models, block diagram models, signal flow graphs models, model of standard test signals, concept of system sensitivity.

State space analysis - concepts of state, state variables and state model, state space representation of linear continuous-time systems, solution of linear time invariant state equation, concept on controllability and observability, illustrative examples.

Module II – [11L]

Developments of models for industrial control devices and systems - dc servomotors, ac servomotors, dc motor speed and position control;

Time domain analysis -time domain performance criterion, transient response of first order and second order with standard test signals, steady state error coefficient, effect of pole–zero addition in system response.

Basic control action- introduction to conventional controller (P, PI, PD, PID), effect of control action, basic knowledge for implementing of controller.

Module III – [7L]

Stability analysis - concept of stability necessary and sufficient condition for stability, Routh stability criterion, concept of relative stability; root locus technique - introduction, the root locus concept, root locus construction rules, stability analysis from the root locus plot.

Module IV – [12L]

Frequency domain analysis techniques -introduction, polar plot: guideline for sketching polar plot, stability analysis; Nyquist plot- introduction, mapping of close contour and principle of arguments, development of Nyquist stability criterion; Bode plot - minimum and non minimum phase system, concept of phase margin and gain margin, procedure for drawing Bode plots. Assessment of relative stability–gain margin and phase margin.

Compensation techniques - the design problems, lead compensation, lag compensation, lead-lag compensation.

Reference

1. Nagrath I. J. and Gopal M., "*Control System Engineering*", 5th Ed., New Age International Private Ltd. Publishers.
2. Kuo B. C., "*Automatic Control Systems*", 8th Ed., Wiley India
3. Ogata K., "*Modern Control Engineering*", 4th Ed., Pearson Education.
4. Dorf R. C. and Bishop R. H., "*Modern Control Systems*" Pearson Education.
5. Norman S. N., "*Control Systems Engineering*", 4th Ed., Wiley India.

Course Outcomes:

After the completion of this course students will be able to:

1. Develop mathematical model of physical and simulated systems in forms of transfer function.
2. Represent the block diagram and signal flow graph of the systems.
3. Investigate the time response of systems and calculate performance indices.

4. Analyze frequency response and stability of linear systems using different methods.
5. Understand the concept of state variable representation and design principle.
6. Check the observability and controllability of the systems.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

<table>
<tr><td colspan="6">Course Name : Microprocessors & Microcontrollers</td></tr>
<tr><td colspan="6">Course Code: AEIE3105</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td><td>4</td></tr>
</table>

Module I - [8L]
Introduction to microcomputer system, History and evolution of microprocessor and microcontrollers and their advantages and disadvantages;
Introduction to 8 bit microprocessor: 8085 microprocessor internal architecture, buses, 8085 pin description; Software instruction set, timing diagram of the instructions, addressing modes and assembly language programming; Interrupts of 8085 processor: classification of interrupts, Programming using interrupts.

Module II - [10L]
Introduction to 8086/8088 Architecture: Architecture, memory segmentation, signal descriptions, clock generator, resetting the microprocessor, wait state inserting, bus buffering, interrupts, instruction set, addressing modes and assembly language programming of 8086/8088.

Module III - [10L]
Introduction to microcontrollers: Intel MCS-51 family features, 8051 architecture, pin configuration, I/O ports and memory organization; Instruction set and basic assembly language programming, interrupts and returns; Interrupts, timer/counter and serial communication;MCS-51 applications: Square wave generation, LED, A/D converter and D/A converter interfacing with 8051;
Brief introduction to PIC microcontroller (16F877): Architecture, pin details, memory layout etc.

Module IV - [12L]
Memory and ADC / DAC interfacing with 8085/ 8086;
Support IC chips: 8255, 8237, 8259 and 8251- Block diagram, pin details, modes of operation, control word(s) format and interfacing with 8085/8086/8051.

References:

1. Ramesh S. Gaonkar, *Microprocessor architecture, programming and applications with 8085/8085A*; Wiley eastern Ltd.
2. B. Ram, *Fundamental of Microprocessor and Microcontrollers*; Dhanpat Rai Publications.
3. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, *Microprocessors and Microcontrollers*; Oxford Publications.
4. A. Nagoor Kani, *8085 Microprocessor and its Applications*; Third Edition, TMH Education Pvt. Ltd.
5. Douglas V. Hall, *Microprocessors & Interfacing*, Tata McGraw-Hill.
6. Ray & Bhurchandi, *Advanced Microprocessors & Peripherals*, Tata McGraw-Hill.
7. Barry B. Brey, *The Intel Microprocessors*, PHI/Pearson Ed. Asia.
8. Muhammed Ali Mazidi and Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded Systems*, Pearson Education Inc.
9. Ajay V Deshmukh, *Microcontrollers Theory and Applications*, Tata McGraw-Hill.
10. Raj Kamal, *Embedded systems- Architecture, Programming and Design*, McGraw Hill Education (India) Pvt. Ltd.

Course outcome:
After the completion of the course the students will be able to:
1. Learn the architecture and function of each pin of 8 bit microprocessor 8085, 16 bit microprocessor 8086/8088, 8051 and PIC microcontroller.

2. Develop the skill in program writing for 8085 microprocessor, 8086 microprocessor, 8051 and PIC microcontroller.
3. Perform memory and I/O interfacing with 8085 microprocessor, 8086 microprocessor.
4. Describe the architecture of different types of programmable peripheral devices and their interfacing with microprocessor, 8086 microprocessor and 8051 microcontroller.

Course Name : Economics for Engineers					
Course Code: HMTS3101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I:
Market: Meaning of Market, Types of Market, Perfect Competition, Monopoly, Monopolistic and Oligopoly market.
The basic concept of economics – needs, wants, utility.
National Income-GDP, GNP. Demand & Supply, Law of demand, Role of demand and supply in price determination, Price Elasticity.
Inflation: meaning, reasons, etc. **(6L)**

Module II:
Business: Types of business, Proprietorship, Partnership, Joint-stock company, and cooperative society – their characteristics.
Banking: role of commercial banks; credit and its importance in industrial functioning. Role of central bank: Reserve Bank of India.
International Business or Trade Environment. **(4L)**

Module III:
Financial Accounting-Journals. Ledgers, Trial Balance, Profit & Loss Account, Balance Sheet.
Financial Statement Analysis (Ratio and Cash Flow analysis). **(8L)**

Module IV:
Cost Accounting- Terminology, Fixed, Variable and Semi-variable costs.
Break Even Analysis. Cost Sheet. Budgeting and Variance Analysis.
Marginal Cost based decisions. **(6L)**

Module V:
Time Value of Money: Present and Future Value, Annuity, Perpetuity.
Equity and Debt, Cost of Capital. **(4L)**

Module VI:
Capital Budgeting: Methods of project appraisal - average rate of return - payback period - discounted cash flow method: net present value, benefit cost ratio, internal rate of return.
Depreciation and its types, Replacement Analysis, Sensitivity Analysis. **(8L)**

References:
1. R. Narayanswami, *Financial Accounting- A Managerial Perspective.* Prentice-Hall of India Private Limited. New Delhi
2. Horne, James C Van, *Fundamentals of Financial Management*. Prentice-Hall of India Private Limited, New Delhi
3. H. L. Ahuja., *Modern Economic Theory*. S. Chand. New Delhi.
4. Newman, Donald G., Eschenbach, Ted G., and Lavelle, Jerome P. *Engineering Economic Analysis.* New York: Oxford University Press. 2012.

Course Name : Sensors and Transducers Lab					
Course Code: AEIE3111					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Comparative studies of some temperature measuring sensors like AD590 IC sensor, RTD and thermistor.
2. Study of capacitive transducer.
3. Study of I/O characteristics of LVDT and hence measure Pressure and displacement through it.
4. Study of a load cell with tensile and compressive load.
5. Rotational speed measurement using magnetic proximity sensor.
6. Measurement of rotational speed measurement using a stroboscopic principle.
7. Comparative studies of some optical sensors like LDR, photo diode and photo transistor.
8. Design a suitable signal conditioning circuit for a given sensor.

Course Outcome:

After the completion of the assignments, the students will be able to

1. Explain working principles of sensors and transducers.
2. Study the working principle of displacement transducers and their applications.
3. Understand principle of working of various transducers used to measure Temperature, comparative study of various transducers.
4. Learn the various types of level measurement transducers and their applications, basic principle of working.
5. Understand applications of various transducers in industry
6. Understand applications of miscellaneous other sensors.

Course Name : Microprocessor Lab					
Course Code: AEIE3112					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Familiarization with 8085A trainer kit components with the process of storing and viewing the contents of memory as well as registers. Repeat the above using 8085A simulator.
2. Study of prewritten programs using basic instruction set (data transfer, load/store, arithmetic, logical) on the simulator and related assignments.
3. Programming using kit/simulator for:
   a. Look up table
   b. Copying and shifting block of memory
   c. Packing and unpacking of BCD numbers
   d. Addition/subtraction of two 8-bit unsigned/signed hex numbers,
   e. Addition of 16-bit unsigned hex numbers.
   f. BCD addition.
   g. Multiplication of two 8-bit unsigned numbers using sequential shift - add method.
   h. Division of two 8-bit numbers.
   i. Factorial calculation.
   j. Binary to ASCII conversion
   k. String matching
   l. String sorting
4. Interfacing with switches and LEDs through PPI 8255A with 8085A trainer kit and glowing LEDs according to read switch status, scrolling, blinking of LEDs using delay subroutines.
5. Interfacing with seven segment displays through 8-bit latch (e.g., 74LS373) using a trainer kit and 8255A PPI employing absolute and partial decoding concept as a peripheral mapped output port with absolute address decoding.
6. ADC, DAC, stepper motor interfacing with 8085A trainer kit and their programming.
7. Programming with hardware interrupts of 8085A microprocessor.
8. Familiarization with EEPROM programming and erasing.

Course Outcome:

After the completion of the course the students will be able to:

1. Select proper instructions and build different assembly language program for 8085 microprocessor.
2. Understand the assembly language programming concept of microprocessor.
3. Design the interfacing of input/output devices with 8085 microprocessor using partial and absolute address decoding.
4. Build assembly language program to control input/output devices for various applications.
5. Analyze the processing of analog signal and generation of various analog signals using interfacing circuit.
6. Realize the programming concept of hardware interrupts in 8085 microprocessor.

Course Name : Industrial Instrumentation Laboratory					
Course Code: AEIE3113					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Familiarization of/with diaphragm, capsule, bellow, Bourdon tube, orifice plate, pitot tube, etc.
2. Calibration of pressure gauges using dead weight tester.
3. Study the characteristics of thermocouple.
4. Study the characteristics of RTD.
5. Fluid flow rate measurement using orifice meter.
6. Measurement of fluid flow rate using rotameter.
7. Level measurement using capacitive/ultrasonic type level transducer.
8. Moisture measurement using moisture analyzer.
9. Measurement of kinematic viscosity using Ostwald viscometer.

Course Outcome:

After completion of this course students will be able to

1. Build a knowledge selecting particular sensing elements for the measurement of physical parameters.
2. Demonstrate the calibration process of pressure measuring devices using dead weight taster.
3. Measure process parameters like flow and level using different measuring devices.
4. Select particular temperature sensing elements for the measurement of temperature.
5. Determine the measurement of viscosity of a specific solution.
6. Formulate moisture percentage of a given sample.

Course Name : Control Engineering Lab					
Course Code: AEIE3114					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Familiarization with MATLAB control system toolbox, MATLAB-SIMULINK toolbox.
2. Block diagram reduction techniques using MATLAB.
3. Transient response of first order and second order system with standard test signals, and study of system parameter using MATLAB .
4. Design and study of the response of first and second order electrical circuits using RC and RLC circuits in hardware.
5. Study of system stability root-locus, Bode plot, Nyquist plot using MATLAB toolbox for any given transfer function with P-Z mapping.
6. Familiarization with state space representation of models using MATLAB toolbox.
7. Study the effect of P, I, D actions on first order / second order simulated processes.
8. Position control of DC servo motor.
9. Speed control of Servo motor or DC motor.

Course Outcomes:

After the completion of this course students will be able to:

1. Understand the concept of pole-zero and transfer function.
2. Derive the overall transfer function from block diagram.
3. Analyze the time response of first order and second order system for different standard input signals and calculate the transient response parameters.
4. Check the stability of a system using root locus method.
5. Find the frequency response of a system using Bode plot and Nyquist plot method.
6. Control the speed of dc motor using different controllers.

11. Implement Flip/Flop(RS, JK, D, T), b)Register,(4/8 bit Synchronized Data Transfer).
12. Design a ripple counter and comparator.
13. Use a multiplexer unit to design a composite ALU.
14. Design a Control Unit.
15. Design a simplified communication protocol.

Course Outcome:

1. After completion of this, students would be able to have adequate knowledge of basics of computer architecture.
2. Students would be able to understand detailed implementation of machine instructions, their classifications and their relevance to programming paradigms.
3. Students would have sufficient knowledge of design implementations of various arithmetic operations such as adder, multiplier etc.
4. Students would be able to design and simulate various combinatorial and sequential logic circuits using Vivado/Xilinx.
5. Students would be able to understand various memory functions.
6. Students would be able to design a formal testbench from informal system requirements.

Course Name : Microprocessors & Microcontrollers Lab					
Course Code: AEIE3115					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

1. Familiarization with 8085A trainer kit components with the process of storing and viewing the contents of memory as well as registers. Repeat the above all using 8085A Simulator.
2. Study of prewritten programs using basic instruction set (data transfer, load/store, arithmetic, logical) on the simulator. Assignments based on above.

3. Programming using kit/simulator for:
   a) Addition/Subtraction of two 8-bit Hex numbers
   b) Packing and unpacking of BCD numbers
   c) Copying and Shifting block of memory
   d) Addition of two 16-bit Hex numbers.
   e) BCD Addition
   f) Multiplication of two 8-bit unsigned numbers using sequential Shift - Add Method.
   g) Binary to ASCII conversion
4. Familiarization of 8086 microprocessor kit/simulator and assembly language programming using 8086 microprocessor/simulator for :
   a) Addition of two 32-bit Hex numbers.
   b) String matching
   c) Shifting a block of data from one memory location to another
   d) Finding the largest/ smallest number from an array
5. Interfacing with switches and LEDs and glowing LEDs according to read switch status and scrolling-
blinking using delay subroutines through
   a) PPI 8255A with 8085A trainer kit
   b) 8051 microcontroller
6. Interfacing with seven segment displays through 8-bit latch (e.g., 74LS373) using- a) 8085A trainer kit, b)8086A trainer kit and 8255A PPI employing absolute and partial decoding concept as a peripheral mapped output port with absolute address decoding.

7. ADC, DAC and Stepper motor interfacing with 8086 microprocessor/8051 microcontroller and their programming.

Course outcome:

After the completion of the course the students will be able to:

1. Understand and apply assembly language of 8085 microprocessor, 8086 microprocessor and 8051 microcontroller.
2. Write programs based on the arithmetical and logical algorithms.
3. Work with microprocessor 8085A,8086Aand microcontroller 8051 interfaced, with LEDs, seven segment displays ADC, DAC, and stepper motor etc.

Course Name : Process Control					
Course Code: AEIE3201					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [6L]

Process control system: process control and automation, basic process control loop block diagram, terms and objectives, piping and instrumentation diagram, servo and regulatory control, classification of variables; process characteristic: process equation, degrees of freedom, process quantity, process potential, process resistance, process capacitance, process lag, process dead time, self-regulating processes, interacting and non- interacting processes; modeling of simple systems: liquid, thermal and gas systems.

Module II – [14L]

Theory of controllers: basic control action, two position, multi-position, floating control modes; continuous controller modes: proportional, integral, derivative; composite controller modes: P-I, P-D, P-I-D, integral wind-up and prevention, auto/manual transfer, bump less transfer, position and velocity algorithm; response of controllers with different test inputs; closed loop response of 1st & 2nd order systems with and without valve, measuring element dynamics; selection of control modes for processes like: level, pressure, temperature and flow; design of electronic/pneumatic controllers; controller tuning methods: evaluation criteria - IAE, ISE, ITAE, process reaction curve method, continuous oscillation method, damped oscillation method, auto tuning.

Module III – [10L]

Final control elements: final control element: actuators (pneumatic actuators, electrical actuators) and control valves (globe, ball, butterfly, gate, pinch), different parts, single & double seated valves, fail-safe operation, valve characteristics, inherent and installed valve characteristics, valve sizing, valve selection, cavitations, flashing, noise, instrument air supply specifications; control valve accessories: air filter regulator, I/P converter, pneumatic positioner, electro-pneumatic positioner, limit switches, motion transmitters; brief study of safety and solenoid valves.

Module IV – [10L]

Complex control system: cascade control, ratio control, feed forward control, overide, split range and selective control, multivariable process control, interaction of control loops; case studies: boiler drum level control, combustion control and ph control; introduction to programmable logic controllers (PLC): basic architecture and functions; input-output modules and interfacing; CPU and memory; relays, timers, counters and their uses; PLC programming and applications; introduction to DCS and SCADA; introduction to digital control; automation hierarchy.

References:

1. Surekha Bhanot, *Process Control: Principles and Applications*, Oxford University Press, 1st Edition, 2008.
2. G.Stephanopoulos, *Chemical Process Control-An Introduction to Theory and Practice* Prentice Hall of India, New Delhi, 2nd Edition, 2005.
3. B.W. Bequette, *Process Control Modeling, Design and Simulation*, Prentice Hall of India, New Delhi, 2004.
4. Curtis D.Johnson, *Process Control: Instrumentation Technology*, Prentice Hall College Div; Custom edition, 2008.

5. C.L.Smith and A.B Corripio., *Principles and Practice of Automatic Process Control*, John Wiley and Sons, New York, 2nd Edition 1998.
6. Paul W. Murril, *Fundamentals of Process Control Theory*, 3rd Edition, ISA press, New York, 2000.
7. Bela G. Liptak, *Instrument Engineers' Handbook,: Process Control*, CRC Press; 3rd edition, 1995.

Course Outcomes:

After the completion of this course students will be able to:

1. Develop the mathematical model for the liquid, thermal and gas systems by their knowledge of Mathematics, Science and engineering.
2. Design and simulate the ON-OFF, P, PI, PID etc. controllers both in hardware and software using electronic components, simulink, MatLab, LabVIEW etc.
3. Identify; analyze the process and accordingly able to choose the modes of controller best suited for the control of the process.
4. Apply their contextual knowledge of control valve to provide engineering solutions of various societal, professional & environmental responsibilities if imposed.
5. Design and develop the ladder logic program in PLC towards the solution of the sequential events performed in industry.
6. Identify, formulate/model, analyze the process and provide solution using knowledge of complex control systems like cascade control, ratio control, feed forward control, overide, split range and selective control, multivariable process control.

Course Name : Electronic Instrumentation and Measurement					
Course Code: AEIE3202					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [12L]

Analogue electronic instruments: introduction, emitter follower voltmeter, D.C. and A.C. voltmeters with operational amplifiers, true R.M.S voltmeter, peak response voltmeter, current-to-voltage converter type electronic ammeters, chopper stabilized amplifiers for measurement of very low voltage and current, electronic multimeter; voltage controlled oscillator, phase locked loop, applications; current mirror, programmable gain amplifier, charge amplifier; voltage to frequency and frequency to voltage converters.

Module II – [10L]

Cathode ray oscilloscopes and its applications: cathode ray tube, deflection amplifiers, sweep generator, oscilloscope automatic time base, dual-trace oscilloscopes, oscilloscope controls, oscilloscope probes, delayed time base oscilloscope, analog storage oscilloscope, sampling oscilloscope, digital storage oscilloscope, applications of oscilloscope.

Module III – [9L]

Digital instruments: introduction, digital voltmeters: characteristics, types- ramp type, dual slope integrating type, successive approximation type, voltage to frequency converter type, microprocessor based ramp type; basic digital displays, LED and LCD panels, display drivers and latches, time base generation with crystal oscillators and dividers; design and implementation of a simple digital frequency meter, errors in frequency measurement– possible remedies, time period and frequency ratio measurement.

Module IV – [9L]

Q meter: basic circuit, series connection method, parallel connection method, sources of errors; electronic ohmmeter; spectrum analyzers; interference and noises; introduction to virtual instrumentation.

References:

1. David Bell, *Electronic Instrumentation & Measurement*; Reston Publishers.
2. H.S. Kalsi, *Electronic Instrumentation*; Tata McGraw Hill.
3. A.D. Helfrick & W.D. Cooper , *Modern Electronic Instrumentation & Measuring Instruments*; Wheeler.
4. D.C. Patranabis, *Principles of Electronic Instrumentation*; PHI.
5. Oliver, Cage, *Electronic Measurements and Instrumentation*; Mc Graw Hill

Course Outcome:

After completion of this course students will be able to

1. Select electronic voltmeters and ammeters suitable for typical measurements.
2. Use electronic instruments like VCO, PLL, current mirror, charge amplifier, voltage to frequency and frequency to voltage converter.
3. Explain the circuit operation of CRO, dual trace oscilloscope, delayed time base oscilloscope.
4. Familiar about digital storage oscilloscope, spectrum analyzer.
5. Explain the working of different types of digital voltmeters, digital frequency meter and digital display unit.
6. Check the quality of a coil, capacitor using Q meter.

Course Name : Advanced Microprocessors and Microcontrollers					
Course Code: AEIE3203					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I - [10L]

Introduction to 8086/8088 architecture: architecture, memory segmentation, signal descriptions, clock generator, resetting the microprocessor, wait state inserting, bus buffering, interrupts; instruction set, addressing modes and assembly language programming of 8086/8088.

Module II - [6L]

Interfacing memory: interfacing static ram (6116–2K, 6264–8K), interfacing EPROM (2764 – 8K, 27256 – 32K), designing memory modules (higher capacity say 512K) using memory chips (say 8K); interfacing I/O devices.

Module III - [12L]

Introduction to microcontrollers: Intel MCS-51 family features, 8051 architecture, pin configuration, I/O ports and memory organization; instruction set and basic assembly language programming; interrupts, timer/counter and serial communication; MCS-51 applications: square wave generation, LED, A/D converter and D/A converter interfacing with 8051.

Module IV - [12L]

PIC microcontroller: introduction, architectural overview, memory organization, data memory and flash memory, interrupts and reset, timer, analog and digital I/O; programming concepts and embedded programming in C; PIC applications: temperature monitoring and control, stepper motor control.

References:

1. Douglas V. Hall, *Microprocessors & Interfacing*, Tata McGraw-Hill.
2. Ray & Bhurchandi, *Advanced Microprocessors & Peripherals*, Tata McGraw-Hill.
3. Barry B. Brey, *The Intel Microprocessors*, PHI/Pearson Ed. Asia.
4. Muhammed Ali Mazidi and Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded Systems*, Pearson Education Inc.
5. Ajay V Deshmukh, *Microcontrollers Theory and Applications*, Tata McGraw-Hill.
6. Muhammed Ali Mazidi, Rolin D. McKinlay, Danny Causey, *PIC Microcontroller and Embedded Systems*, Pearson Education Inc.
7. Raj Kamal, *Embedded systems- Architecture, Programming and Design*, McGraw Hill Education (India) Pvt. Ltd.

Course outcome:

After the completion of the course the students will be able to:

1. Describe the architecture of 16 bit microprocessor (8086/8088), 8051 and PIC (PIC16F877) microcontroller
2. Develop the skill in program writing for 8086 microprocessor, 8051 and PIC microcontroller.
3. Understand and realize the interfacing of memory, input/output devices with 8086 microprocessor.
4. Understand the interrupts of 8086 microprocessor, 8051 and PIC microcontroller.
5. Understand the use of timer/counter and serial data communication process in 8051 microcontroller.
6. Apply the knowledge to interface different type of I/O devices with 8051 and PIC microcontroller.

Course Name : Process Control Lab					
Course Code: AEIE3211					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Study of flow, level and pressure processes and construction of P&I diagram in accordance with ISA guidelines /Standards.
2. Study of typical pressure control loop having pressure source, pressure transmitter, control valve and conventional PID controller.
3. Study of a typical level control loop having level transmitter, control valve and conventional PID controller.
4. Study of a typical air duct flow monitoring and control.
5. Study of a furnace temperature control loop.
6. PLC programming through PC.
7. Study of single element & three element control of boiler drum level and burner management system using boiler simulation software.

Course Outcomes:

After completion of this course students will be able to

1. Draw and explain P&I diagram of flow, pressure, level and temperature control loop from their engineering knowledge.
2. Analyze the process responses with respect to various process parameter values.
3. Use software tool to study the close loop process responses.
4. Create ladder logic diagram for various sequential operations commonly used in industrial environment.
5. Conduct experiments either in group or by individual means.
6. Provide engineering solutions of various societal, professional & environmental responsibilities.

Course Name : Electronic Instrumentation and Measurement Lab					
Course Code: AEIE3212					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Study of static and dynamic characteristics of a measuring instrument.
2. Acquaintance with basic structure of DMM and measurement of different electrical parameters.
3. Realization of data acquisition system.
4. Spectrum analysis using spectrum analyzer.
5. Realization of a V-to-I & I-to-V converter.
6. Study of VCO (voltage controlled oscillator) & PLL (phase locked loop).
7. Study of analog to digital converter.
8. Study of digital to analog converter.
9. Statistical analysis of errors in measurement using MATLAB.

Course Outcomes:

After completion of this course students will be able to

1. Use data acquisition system to gather output data from transducer.
2. Able to make statistical analysis on large number of data.
3. Implement analog to digital and digital to analog converter.
4. Get hands on experience on voltage controlled oscillator, phase locked loop and spectrum analyzer.
5. Design voltage to current converter, current to voltage converter and digital multimeter.
6. Study static and dynamic characteristics of measuring instruments.

Course Name : Advanced Microprocessors and Microcontrollers Lab					
Course Code: AEIE3213					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

Experiments with 8086 microprocessor:

1. Familiarization of 8086 microprocessor kit/simulator, its operation along with prewritten programs on it using data transfer, load/store, arithmetic and logical instructions.
2. Write assembly language programs (ALP) using 8086 microprocessor/simulator on the following:
   i) Finding the largest/ smallest number from an array
   ii) Arranging numbers in ascending/descending order
   iii) Shifting a block of data from one memory location to another
   iv) Addition of a series of BCD numbers
   v) String matching

Experiments with 8051/ PIC 16F or 18F series microcontroller:

3. Write a program using microcontroller to read a digital input from a push button switch and toggle a LED ON and OFF every time the switch is pressed.
4. Write a program using microcontroller to develop a 4-bit binary counter and display the counts using seven segment displays.
5. Write a program using microcontroller to interface LCD and display characters.
6. Write a program using microcontroller to generate square wave, saw tooth wave and triangular wave of specified frequency.
7. Write a program to develop a temperature monitoring system using temperature sensor, LCD and microcontroller.
8. Write a program to perform pulse width modulation of a voltage signal using a microcontroller.
9. Write a program to control a stepper motor/servo motor and control it's rotational direction, speed and number of steps using microcontroller.
10. Write a program to transmit data through serial port between microcontroller and PC.
11. Write a program to interface a matrix keypad with microcontroller and display the pressed key information on a character LCD.

Course Outcomes:

After the completion of the course the students will be able to:

1. Understand the assembly language programming concept of 8086 microprocessor.
2. Develop 8051/ PIC 16F or 18F series microcontroller based systems to implement various tasks such as switch state read, development of binary counter, data transfer, etc.
3. Design the interfacing of display devices (LED/LCD) with microcontroller and write program using them.
4. Build program to control input/output devices like motor (stepper motor/servo motor), temperature sensor, key board, etc., with microcontrollers for various applications.
5. Build program using microcontroller to generate different waveforms (like square wave, saw tooth wave) and perform pulse width modulation of a voltage signal.
6. Design and implement an embedded system using 8051/ PIC 16F or 18F series microcontrollers.

Course Name : Technical Seminer I					
Course Code: AEIE3221					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

The seminar should be on any topic having relevance with Instrumentation engineering and related areas of technology. The topic should be decided by the student and concerned teachers. Seminar work shall be in the form of presentation to be delivered by the student regularly throughout the semester. The candidate will deliver a final talk on the topic at the end of the semester and assessment will be made by a group of internal examiners.

Course Outcomes:

After the completion of the course the students will be able to:

1. Explore literature to identify promising new directions of various cutting edge technologies to solve real-world issues.
2. Build up knowledge in the field engineering, with specialization related to Electronics and Instrumentation engineering and the ability to integrate information across disciplines.
3. Prepare quality presentation on a topic with proper organization and demonstrate the content properly with the aid of audio-video, pictures and documents, etc.
4. Communicate effectively by making an oral presentation before an evaluation committee.
5. Interact efficiently with audience.
6. Develop habits of maintaining regularity and punctuality.

Course Name : Fundamentals of Digital Signal Processing					
Course Code: AEIE3231					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [10L]

Discrete-time signals and systems: discrete time signals- generation of discrete and digital signals, sampling of continuous time signals and aliasing, classification of discrete time signals, mathematical operations on discrete time signals- time shifting, scaling, folding, addition and multiplication; correlation of discrete time signals; discrete time systems: description, block diagram representation, classification of discrete time systems- static and dynamic, time invariant and time variant, linear and nonlinear, stable and unstable, FIR and IIR and recursive and non-recursive systems; response of LTI discrete time system; linear and circular convolution.

Module II - [6L]

Z-transform and its applications: z-transform –direct z-transform, inverse z-transform, properties of z-transform, rational z-transforms- poles and zeros, pole location and time domain behavior for causal signals; system function of linear time invariant system; inverse z-transform; one-sided z-transform; analysis of Linear Time Invariant (LTI) systems in z-domain.

Module III-[10L]

Signal transforms: Fourier Transform of Discrete-Time signals (DTFT)- definition, frequency spectrum of discrete time signal, inverse discrete time Fourier transform; Discrete Fourier Transform (DFT) – definition of forward and inverse DFT, frequency spectrum using DFT, properties and limitations of DFT; Fast Fourier Transform (FFT) – algorithm, 8-point DFT using Decimation in Time (DIT) radix-2 FFT; drawbacks of Fourier transform; introduction to time-frequency analysis- Short Time Fourier Transform (STFT), Continuous and Discrete Wavelet Transform (CWT and DWT) and their applications in signal processing.

Module IV- [10L]

Digital filter design and realizations: design of FIR filters- Fourier series method, frequency sampling method and window technique; design of IIR filters- approximation of derivatives, impulse invariance technique and bilinear transformation; structures for realization of FIR and IIR filters- direct form-I, direct form-II, cascade, parallel and linear phase structure of FIR filters; finite word length effect in digital filters.

References:

1. John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, 3rd ed, Pearson Education Inc., New Delhi, India.
2. Sanjit K. Mitra, *Digital Signal Processing- A computer based Approach*, McGraw-Hill.
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, *Digital Signal Processing*, TMH, 2nd Edition, 2010.
4. A.V. Oppenheim, R.W. Schaffer and John R. Buck, *Discrete Time Signal Processing*, 3rd Edition, Prentice-Hall Signal Processing Series, 2009.
5. Nagoor Kani, *Signals and Systems, McGraw Hill Education (India) Privet Limited, New Delhi, 2013.*

Course Outcomes:

After the completion of the course, the students will be able to:

1. Characterize, analyze and perform mathematical operations on discrete time signals
2. Characterize and analyze the properties of discrete time systems
3. Analyze a discrete linear time invariant system using Z-transform
4. Perform Fourier Transform of Discrete-Time signals and their properties and Fast Fourier Transform algorithms
5. Design algorithms of digital FIR and IIR filters according to the given specification
6. Realize structure of a digital filter for given transfer function

Course Name : Mobile Communication					
Course Code: AEIE3232					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [8L]

Cellular concept and system design fundamentals: introduction to wireless communication-evolution of mobile communication, mobile radio systems- examples, trends in cellular radio and personal communications; cellular concept- frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, trunking and grade of service, improving coverage and capacity of cellular systems.

Module II – [9L]

Mobile radio propagation: reflection, ground reflection model (2 ray model), diffraction, practical link budget design using path loss models, small-scale multipath propagation, parameter of multi-path channels, types of small scale fading, Rayleigh and Ricean distribution, diversity, rake receiver; instrumentation for multiple access technique in wireless communications: review of frequency division multiple access (FDMA) and time division multiple access (TDMA), spread spectrum multiple access (SSMA), space division multiple access (SDMA).

Module III – [10L]

Introduction to modern technologies: GSM network architecture, signaling protocol architecture, identifiers, channels, introduction frame structure, speech coder RPE-LTP, authentication and security, call procedure, handoff procedure, services and features; GPRS and EDGE: architecture and services offered; IS-95 A & B (CDMA-1): frequency and channel specifications of forward and reverse CDMA channel, packet and frame formats, mobility and radio resource management.

Module IV – [9L]

Wireless network & access protocols: wireless LAN – IEEE 802.11 standards – architecture – services – wireless local loop (WLL), WAP model mobile, location based services, WAP gateway, WAP protocols, WAP user agent profile-caching model and wireless bearers for WAP; 3G Technology: IMT-2000/UMTS: network architecture, air interface specification, forward and reverse channels in W-CDMA and CDMA 2000.

References:

7. Schiller, *Mobile Communication;* Pearson Ed.
8. C.Y Lee, *Mobile Communication*; Wiley.
9. Rappaport. T.S., *Wireless communications*; Pearson Education, 2003.
10. Simon Haykin & Michael Moher, *Modern Wireless Communications*; Pearson Education, 2007.
11. Gordon L. Stuber, *Principles of Mobile Communication*; Springer International Ltd., 2001.

Course Outcomes:

After the completion of the course students will be able to

1. Explain cellular concept and the strategies associated with cellular communication
2. Analyze mobile radio propagation models considering losses and fading
3. Compare multiple access techniques used for mobile communications
4. Evaluate GSM and CDMA technologies with their architecture, frame structure, system capacity as well as services provided by them
5. Design wireless local area networks utilizing the wireless access protocols
6. Determine the merits and limitations of 3G technology

Course Name : Opto Electronics and Fibre Optics					
Course Code: AEIE3233					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [8L]

Optoelectronics: characteristics of optical emission, electro-luminescence, photo electric effect, photo conducting effect, photo voltaic effect.

Module II – [8L]

Photo diode: PIN photodiode, hetero junction diode, avalanche photo diode, phototransistor, LDR, photo voltaic cell. LED: power and efficiency calculation, structure of LED and its characteristics, hetero-junction LED.

Module III - [10L]

LASER fundamentals: fundamental characteristics of lasers, three level and four level lasers, properties of lasers, laser modes, resonator configuration-Q switching and mode locking, cavity damping, types of lasers- gas lasers, liquid laser, solid lasers, semi-conductor lasers: double hetero-junction broad area laser, stripe geometry DH laser; industrial applications of LASER: laser for measurement of distance, length, velocity, acceleration and atmospheric effect; material processing: laser heating, welding, melting and trimming of material-removal and vaporization.

Module IV - [10L]

Optical fibers and their performances : principle of light propagation through fiber, different types of fibers and their properties, fiber characteristics, absorption losses, scattering losses, dispersions, connectors; industrial applications of optical fiber; fiber optic sensors, fiber optic instrumentation system; different types of modulators, infer metric method of measurement of length, Moire fringes, birefringence fringes, measurement of pressure, temperature, current, voltage, liquid level and strain.

References:

1. J.M. Senior, *Optical Fibre Communication, Principles and Practice;* Prentice Hall of India, 1985.
2. J. Wilson and J.F.B. Hawkes, *Introduction to Opto Electronics*; Prentice Hall of India, 2001.
3. Donald J.Sterling Jr, *Technicians Guide to Fibre Optics;* 3rd Edition, Vikas Publishing House, 2000.
4. M. Arumugam, *Optical Fibre Communication and Sensor;* Anuradha Agencies, 2002.
5. John F. Read, *Industrial Applications of Lasers;* Academic Press, 1978.
6. Monte Ross, *Laser Applications*; McGraw Hill, 1968.
7. G. Keiser, *Optical Fibre Communication*; McGraw Hill, 1995.
8. S.M. Zse, *Physics of Semiconductor Devices;* Wiley; Third edition , 2008
9. Ajay Ghatak, *Optics*; TMH, 2012.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. Learn the various optical source materials, LED structures, quantum efficiency, Laser diodes.

3. Learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration
4. Specify and analyze optical optoelectronic devices in optical fiber communication.
5. Specify the different kind of losses, signal distortion in optical wave guides and other signal degradation factors
6. Gain the basic concepts of optoelectronics, properties and industrial applications.

Course Name : Biomedical Instrumentation					
Course Code: AEIE3241					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I- [7L]
Introduction to the physiology of cardiac, nervous, muscular and respiratory systems; basic medical instrumentation system; origin of bioelectric signals: resting and action potentials; electrode theory, electrode tissue interface, polarizable and non-polarizable, different types of electrodes- hydrogen, calomel, Ag-AgCl, pH, pO_2, pCO_2 electrodes, selection criteria of electrodes.

Module II – [6L]
Biomedical transducers: different physiological variables: blood pressure, pulse rate, cardiac output, body temperature, blood pH etc.; different types of transducers: piezoelectric, strain-gauge, LVDT, magnetic induction, thermocouple, thermistor, diaphragm etc. and their selection for biomedical applications.

Module III-[9L]
Cardiovascular measurement: the heart and other cardiac systems, measurement of blood pressure & blood flow, heart sounds, cardiac output and cardiac rate; ECG : amplifiers and leads, cardiac pace-maker, defibrillator.

Module IV-[8L]
Measurement of electrical activities in muscles and brain: EMG, EEG, and their interpretations; medical imaging: ultrasound imaging, radiography, CT Scan, MRI and applications; philosophy of biotelemetry: transmission and reception aspects of biological signals via long distances; electrical safety of patients.

References:

1. L Cromwell, *Biomedical Instrumentation and Measurements*; Pearson Education.
2. R. S. Khandpur, *Handbook of Biomedical Instrumentation;* TMH.
3. J. S. Webster, *Medical Instrumentation Application and Design;* Wiley India Pvt. Limited.
4. J. J. Carr & J. M. Brown, *Introduction to Biomedical Equipment Technology;* Pearson Education.
5. B. R. Astor, *Introduction to Biomedical Instrumentation and Measurement;* McMillan.
6. S. Chatterjee & A. Miller, *Biomedical Instrumentation*; Delmar Cengage Learning.

Course Outcomes:

After the completion of the course, the students will be able to

1. Describe the origin of biopotentials and explain the role of biopotential electrodes and to design and operate biopotential amplifiers.
2. Inspect common bioelectrical and biochemical signals and sensors with distinguish characteristic features.
3. Correlate working principle of different sensors used to measure process variables with that of cardiac variables like- blood flow rate, blood pressure, heart sound, cardiac outputs etc.
4. Explain the design of cardiac pacemaker, Defibrillator or other therapeutic instruments.
5. Understand the various method of medical imaging systems like-MRI, X-Rays, Ultrasounds along with the concept of bio-telemetry.
6. Understand the patient safety issues related to biomedical Instrumentation.

Course Name : Advanced Sensors					
Course Code: AEIE3242					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	0	3	3

Module I – [9L]

Overview of micro-sensors: principle of transduction; classification of micro-sensors; chemical, thermal, pressure, acoustic, optical, electrical, mechanical, biological sensors, their calibration and determination of characteristics; materials for micro-sensors: substrates and wafers, silicon as substrate material; silicon compounds: silicon dioxide, silicon carbide, silicon nitride and polycrystalline silicon, silicon piezo-resistors, gallium arsenide, quartz, piezoelectric crystals, polymers.

Module II - [10L]

Micro-fabrication process: IC technology used in micro sensor system; crystal growth and wafer making, different techniques of deposition; physical vapor deposition - evaporation, thermal oxidation, sputtering, epitaxy, ion implantation and diffusion; chemical vapor deposition- LPCVD, APCVD, PECVD, spin coating, electrochemical deposition; pattern generation and transfer- masking, photolithography, photoresists and applications, light sources, photo resist development and removal; different types of etching: chemical and plasma; overview of micro-manufacturing techniques: bulk micro-machining, surface micro-machining, LIGA.

Module III - [9L]

Testing and packaging: partitioning, layout, technology constraints, scaling, compatibility study; scaling laws in miniaturization; examples of selected micro sensors.

Module IV - [9L]

Smart sensors: introduction; nature of semiconductor sensor output, information coding, integrated sensor principles, sensor networking, present trends.

References:

1. J. W Gardner, V. K. Varadan, *Microsensors, MEMS And Smart Devices*, Wiley, 2001.
2. Stephen Beedy, *MEMS Mechanical Sensors*, Artech House, 2004
3. N. P. Mahalik, *MEMS*, McGraw Hill, 2007
4. Jon Wilson, *Sensor Technology Handbook*, Elseiver, 2005.
5. Leondes, Cornelius T. (Ed.), *Mems/Nems Handbook Techniques and Applications*, Springer, 2006
6. Mohamed Gad-el-Hak, *The MEMS Handbook*, CRC Press; 2nd edition, 2005.
7. G. Steetman and Sanjay Banerjee, *Solid State Electronic Devices*, Prentice Hall; 6th edition, 2005.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Know the concepts of micro sensors.
2. Know the basic concepts of sensors, selection criteria and industrial applications.
3. Acquaint the fundamentals of sensing materials, properties and industrial applications.
4. Understand microfabrication techniques.
5. Explain the need for smart sensors
6. Tell the importance of choice of materials in microfabrication techniques.

Course Name : Non Conventional Energy Sources					
Course Code: AEIE3243					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [8L]

Introduction: fossil fuel based systems, impact of fossil fuel based systems, non conventional energy – seasonal variations and availability, renewable energy – sources and features, hybrid energy systems, distributed energy systems and dispersed generation (DG); solar thermal systems: solar radiation spectrum, radiation measurement, conversion technologies, applications- heating, cooling, drying, distillation, power generation.

Module II – [9L]

Solar photovoltaic systems: operating principle, photovoltaic cell concepts - cell, module, array, series and parallel connections, maximum power point tracking, applications - battery charging, pumping, lighting, solar cell power plant, limitations; wind energy: wind patterns and wind data, site selection, types of wind mills, characteristics of wind generators, performance and limitations of energy conversion systems, load matching, recent developments.

Module III – [8L]

Energy from bio-mass: resources and conversion process: bio gas conversion, bio gas plant, bio mass gasifier, cogeneration, bio-diesel; fuel cells: principle of working of various types of fuel cells - working, performance and limitations, advantages of fuel cell power plants, future potential of fuel cells; geothermal energy: resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

Module IV – [11L]

Energy from the ocean: ocean thermal electric conversion (OTEC) systems like open cycle, closed cycle, hybrid cycle, prospects of OTEC in India; energy from tides: basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy; energy power from wave: wave energy conversion devices, advantages and disadvantages of wave energy; concept of energy management and audit.

References:

1. G.D. Rai, *Non-conventional energy sources*; Khanna Publishers.
2. H.P. Garg & Jai Prakash, *Solar Energy: Fundamentals and Applications;* Tata McGraw Hill.
3. Bansal, Kleeman & Melisa, *Renewable Energy Sources & Conversion Technology*; Tata McGraw Hill New Delhi.
4. Twidell & Weir, *Renewable Energy Resources*; ELBS
5. D.S. Chauhan, *Non-conventional Energy Resources*; New Age International.
6. C.S. Solanki, *Renewal Energy Technologies: A Practical Guide for Beginners*; PHI Learning.
7. Peter Auer, *Advances in Energy System and Technology- Vol. I & II*; Edited by Academic Press.

Course Outcomes:

After the completion of the course students will be able to

1. Discuss the issue of fuel availability and analyze the supply and demand of fuel in the world
2. Illustrate solar energy conversion techniques
3. Compare the working principle and environmental impacts of a biomass based power plant with a coal-fired power plant
4. Estimate the scope of wind energy for electricity generation
5. Explain the process to harness energy from nonconventional energy sources like geothermal, tidal, ocean-thermal and wave
6. Evaluate the economical use of renewable energy resources compared to conventional energy sources

Seminar-I [INFO3221]

Course Outcomes:

After completion of this course, students will be able to:

1. Acquire presentation skills.
2. Acquire discussion skills.
3. Acquire listening skills.
4. Acquire argumentative skills and critical thinking.
5. Acquire questioning skills.
6. Acquire interdisciplinary inquiry.

2. Develop the skill in program writing for 8085 microprocessor, 8086 microprocessor, 8051 and PIC microcontroller.
3. Perform memory and I/O interfacing with 8085 microprocessor, 8086 microprocessor.
4. Describe the architecture of different types of programmable peripheral devices and their interfacing with microprocessor, 8086 microprocessor and 8051 microcontroller.

Course Name : Economics for Engineers					
Course Code: HMTS3101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module I:
Market: Meaning of Market, Types of Market, Perfect Competition, Monopoly, Monopolistic and Oligopoly market.
The basic concept of economics – needs, wants, utility.
National Income-GDP, GNP. Demand & Supply, Law of demand, Role of demand and supply in price determination, Price Elasticity.
Inflation: meaning, reasons, etc. **(6L)**

Module II:
Business: Types of business, Proprietorship, Partnership, Joint-stock company, and cooperative society – their characteristics.
Banking: role of commercial banks; credit and its importance in industrial functioning. Role of central bank: Reserve Bank of India.
International Business or Trade Environment. **(4L)**

Module III:
Financial Accounting-Journals. Ledgers, Trial Balance, Profit & Loss Account, Balance Sheet.
Financial Statement Analysis (Ratio and Cash Flow analysis). **(8L)**

Module IV:
Cost Accounting- Terminology, Fixed, Variable and Semi-variable costs.
Break Even Analysis. Cost Sheet. Budgeting and Variance Analysis.
Marginal Cost based decisions. **(6L)**

Module V:
Time Value of Money: Present and Future Value, Annuity, Perpetuity.
Equity and Debt, Cost of Capital. **(4L)**

Module VI:
Capital Budgeting: Methods of project appraisal - average rate of return - payback period - discounted cash flow method: net present value, benefit cost ratio, internal rate of return.
Depreciation and its types, Replacement Analysis, Sensitivity Analysis. **(8L)**

References:

1. R. Narayanswami, *Financial Accounting- A Managerial Perspective.* Prentice-Hall of India Private Limited. New Delhi
2. Horne, James C Van, *Fundamentals of Financial Management*. Prentice-Hall of India Private Limited, New Delhi
3. H. L. Ahuja., *Modern Economic Theory*. S. Chand. New Delhi.
4. Newman, Donald G., Eschenbach, Ted G., and Lavelle, Jerome P. *Engineering Economic Analysis.* New York: Oxford University Press. 2012.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Principles of Management					
Course Code: HMTS3201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**2**

Module 1:
Management: Definition, nature, purpose and scope of management, Skills and roles of a Manager, functions, principles; Evolution of Management Thought: Taylor Scientific Management, Behavioral Management, Administrative Management, Fayol's Principles of Management, Hawthorne Studies. **(4L)**
Module 2:
a) **Planning:** Types of plans, planning process, Characteristics of planning, Traditional objective setting, Strategic Management, premising and forecasting.
b) **Organizing:** Organizational design and structure, Coordination, differentiation and integration.
c) **Staffing:** Human Resource Management and Selection, Performance appraisal and Career strategy, Managing Change.
d) **Decision-Making:** Process, Simon's model of decision making, creative problem solving, group decision-making.
e) **Coordinating:** Concepts, issues and techniques.
f) **Controlling:** Concept, planning-control relationship, process of control, Types of Control, Control Techniques (**8L)**
Module 3:
Span of management, centralization and de-centralization Delegation, Authority & power - concept & distinction, Line and staff organizations. **(4L)**
Module 4:
Organization Behaviour: Motivation, Leadership, Communication, Teams and Team Work**. (6L)**
Module 5:
Management by Objectives (MBO): Management by exception; Styles of management: (American, Japanese and Indian), McKinsey's 7-S Approach, Self Management. **(2L)**

References:
1. Harold Koontz & Heinz Weihrich, Essentials of Management, TMH.
2. Stoner, Freeman, Gilbert Jr., Management, PHI.
3. Bhatt & Kumar, Principles of Management, OUP.

Dr. Subhashis Majumder

Course Name : Circuit Theory					
Course Code: ELEC3001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Total: 40L
Module-I
Network equations: Formulation of Node & Mesh equations. Loop and node variable analysis. Network Theorems: Thevenin's, Norton's and Superposition theorem applied to circuits containing dependent sources. [10L]

Module-II
Laplace Transform: Review of Laplace transform. Properties of Laplace transform. Transform of standard periodic and non periodic waveforms. Circuit elements and their transformed equivalents. Transient and steady state response of RL, RC, LC and RLC with or without stored energy. Concept of natural frequency and damping. Sketching transient response, determination of time domain specifications. [10L]

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Personality Development					
Course Code: HTMS3221					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**0**	**1**	**1**

Module 1

Self-Growth

(i) Self Growth- Maslow's Hierarchy of Needs Theory
(ii) Anger, Stress & Time Management- Theories and application
(iii) SWOT Analysis

Module II

Stepping Up

(i) Growth & Environment
(ii) Competitive Spirit
(iii) Responsibility Factor

Module III

Professional Communication

(i) Impression Management- theory on social psychology
(ii) Employability Quotient
(iii) Cross-cultural communication

Module IV

Leadership & Team Playing

(i) Leadership & Team Playing: Theories, Styles, Stages
(ii) Motivation, Negotiation Skills, Conflict Management
(iii) Planning & Envisioning: Initiative and Innovation in the Work Environment- De Bono's Six Thinking Hats

References:

1. Personality Development and Soft Skills by Barun K. Mitra, Oxford University, 2011
2. Soft Skills: An Integrated Approach to Maxmise Personality by Gajendra Singh Chauhan and Sangeeta Sharma, Wiley, 2016.
3. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success by Gopalaswamy Ramesh and Mahadevan Ramesh, Pearson, 2010

Course Name: HEAT TRANSFER					
Course Code: MECH 3102					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course Outcomes:

After completion of the course, the students will be able to:

CO1 Identify the basic laws of heat transfer, and implement the concepts to account for the heat transfer in thermal analyses of engineering systems.

CO2 Judge heat transfer rates involving one-dimensional steady-state heat conduction in simple geometries

CO3 Examine heat transfer rates for extended bodies and heat transfer in transient conduction. Explain and appraise radiation heat transfer between black surfaces, as well as between gray bodies.

CO4 Explain concepts related to convection phenomena, examine practical situations where convection heat transfer is dominant, use correlations to describe forced convection phenomena for external and internal flows, and investigate practical problems by applying the knowledge.

CO5 Analyze heat transfer for (i) free convection and (ii) laminar film condensation on a vertical flat plate, and investigate practical situations where such phenomena are predominant.

CO6 Describe boiling heat transfer phenomenon, analyze heat exchanger performance by using the methods of LMTD and ε-NTU, and assemble all relevant concepts to design heat exchanger applications.

Sl. No.	Syllabus	Contact Hrs
Module 1	Fundamentals: Modes of heat transfer: Physical origins and rate equations; Relationship to Thermodynamics; Analysis of heat transfer problems-methodology; Relevance of heat transfer.	1
	Introduction to Conduction: The conduction rate equation (Fourier's law); Thermal conductivity, isotropic, homogeneous medium, effect of temperature on thermal conductivity of solids, liquids and gases; Thermal diffusivity.	2
	The heat diffusion equation in Cartesian, Cylindrical and Spherical coordinates and its reduction to specific cases.	2
	One-dimensional, steady-state conduction without heat generation: Plane Wall — temperature distribution, thermal resistance, electrical analogy, composite wall, thermal contact resistance.	3
	Radial Systems— the Cylinder and the Sphere, critical thickness of insulation; Overall heat transfer coefficient.	2
	One-dimensional, steady-state conduction with heat generation: Plane wall and radial systems.	2

Module 2	Heat Transfer from Extended Surfaces: General conduction-convection analysis, types of fin, heat flow analysis through fin of uniform cross section (infinitely long, insulated tip, fixed rate of heat loss at the tip and tip with fixed temperature), efficiency and effectiveness of fin Transient Conduction: Lumped capacitance method, thermal time constant, validity of lumped parameter approach, Biot number, Fourier number Radiation: Physical mechanism of thermal radiation, spectral radiation intensity, spectral emissive power and total emissive power; Blackbody radiation: definition of black body, radiation laws, emissivity, absorptivity, reflectivity, transmissivity, Kirchoff's identity; Gray body. Radiation exchange between black bodies, radiation shape factors and various relationships; Heat exchange between non-black bodies, concept of opaque, gray and diffuse surface, irradiation, radiosity, radiation heat exchange among surfaces forming enclosure.	3 2 3 3
Module 3	Forced Convection: Principles of convection; Newton's law of cooling and significance of heat transfer coefficient. Dimensional analysis applied to forced convection; Dimensionless numbers and their physical significance; Empirical correlations Derivation of continuity, momentum and energy equations in 2-D The velocity and thermal boundary layer and its significance; Local and average convection coefficients; Momentum and energy equations of laminar boundary layer on a flat plate; Similarity methods. General solution of von Kármán integral momentum and energy equation of boundary layer; Relation between fluid friction and heat transfer; Introduction to turbulent boundary layer heat transfer. Forced Convection (Continued): Heat transfer in laminar tube flow; Bulk temperature; Empirical relations for pipe and tube flow.	1 1 3 3 4 2

Module 4	Natural Convection: Mechanism of free convection; Velocity and thermal boundary layers.	2
	Free convection heat transfer on a vertical flat plate; Empirical relations for free convection.	2
	Introduction to Boiling Heat Transfer: General aspects, Boiling regimes, Bubble shape, size, growth and collapse, Critical diameter; Factors affecting nucleate boiling.	1
	Condensation Heat Transfer: General aspects; laminar film condensation.	1
	Heat Exchangers: Uses and types of heat exchangers; Parallel and counter-flow types.	1
	Introduction to LMTD method; correction factors; Fouling factor.	2
	ϵ-NTU method for heat exchangers	2
		48

Text Books:

1. Introduction to Heat Transfer- S.K. Som, PHI, 2e
2. Heat & Mass Transfer, P.K. Nag, TMH, 3e

Reference Books:

1. Fundamentals of Heat and Mass Transfer-Incropera, DeWitt, Bergmam, & Lavine, Wiley India
2. Heat and Mass Transfer: A Practical Approach- Yunus A. Cengel, McGraw-Hill, 2007
3. Heat Transfer-J P Holman &Souvik Bhattacharyya, TMH
4. NPTEL lecture series on heat transfer

09/08/2022

Course Name : FLUID MECHANICS & HYDRAULIC MACHINES LAB					
Course Code: MECH 3111					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	Identify different flow patterns and regimes.
CO 2	Evaluate Coefficient of Discharge of Flow Measuring Devices.
CO 3	Understand the determination of airflow velocity by a Pitot Static Tube.
CO 4	Analyze the validity of the Bernoulli's equation for steady flow of water in a tapered duct.
CO 5	Demonstrate practical understanding of friction losses in internal pipe flow.
CO 6	Evaluate the overall efficiencies of Pelton turbine, Francis Turbine and Centrifugal pump.

List of Experiments:

1. Characteristics of Laminar & Turbulent flow.
2. Verification of Bernoulli's Equation.
3. Determination of Coefficient of Discharge of Flow Measuring Devices in pipe flow.
4. Pipe friction characteristics in different flow regimes for flow through pipes.
5. Determination of Coefficient of Discharge of V-Notch & Rectangular Weir.
6. Determination of airflow velocity by using a Pitot Static Tube.
7. Performance test of a Centrifugal Pump.
8. Performance test of a Pelton Turbine.
9. Performance test of a Francis Turbine.

N.B: A minimum of six experiments must be performed in the semester.

09/08/2022

Course Name : DESIGN PRACTICE-I					
Course Code: MECH 3112					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Justify deference between ‘Computer Aided Design’ and ‘Computer Aided Drafting’ with its practical interpretations.
CO 2	Select most appropriate 3-D modeling tools of a CAD Software named ‘PTC Cre Parametric 2.0’ to create 3-D model of any machine part parametrically in simplest possible way.
CO 3	Execute advanced modeling job of a very complicated part with the CAD software ‘PTC Creo Parametric’ using its advanced 3-D modeling tools like ‘Helical Sweep’, ‘Variable Section Sweep’, ‘Swept Blend’ etc.
CO 4	Assemble 3-D parts of a whole machine with ‘PTC Creo Parametric’ software in fully constrained way without any type of interference created.
CO 5	Generate detailed drafting parametrically along with sectional view and enlarged view incorporating detailed dimensioning and industrial standards using a the CAD Software ‘PTC Creo Parametric’
CO 6	Handle any machine modeling job using a CAD Software like ‘PTC Creo Parametric’ staring from part modeling to automated drafting along with the generation of detailed BOM.

Experiment/ Study	Syllabus	Contact Hrs.
1	**Introduction:** A comparative discussion on Computer Aided Design	3

	(CAD) software and Computer Aided Drafting (CAD) software, Discussion of different capabilities of a CAD software and different categories of its tools.	
2	**3D modeling tools:** Discussion about following tools of a 3D modeling software like ***PTC Creo Parametric*** with suitable examples-Extrude, Revolve, Sweep, Blend, Variable section sweep, Sweep-Blend, Helical Sweep, Hole, Pattern, Mirror, Copy, Round, Chamfer, Draft and Shell.	6
3	**Assembly:** Discussion on the methodology about generating an assembly of different machine parts following perfect constraints using software like ***PTC Creo Parametric.***	6
4	**Drafting:** A detailed discussion on the methods of generating detailed drafting from a 3-Dimensional model using software like ***PTC Creo Parametric.***	3
5	**To design and create 3D model of following machine part and assembly and to generate their 2D drafting automatically using software like *PTC Creo Parametric.*** a) Knuckle/Cotter joint b) Bolted bracket/ turn buckle c) Helical compression spring/ Leaf spring	9
6	**To design and create 3D model of following machine part and assembly and to generate their 2D drafting automatically using software like *PTC Creo Parametric.*** a) Screw jack b) Shaft Couplings c) Belt pulley drive	9
	Total	**36**

Recommended Book:

1. PTC Creo Parametric 3.0- for engineers and Designers by Prof. Sham Tickoo, Dreamtech Press.

09/08/2022

Course Name : SEMINAR – I					
Course Code: MECH 3121					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	**Prioritize** himself/ herself by **learning** to **choose** a novel topic of his own interest.
CO 2	**Compile** and **reproduce** facts and data in presentations with audio visual format.
CO 3	**Adapt** the manners, behaviors and strategies to **present/employ** own ideas.
CO 4	**Build** himself/herself to **value** corporate relationships in a real life environment .
CO 5	**Learn** to **argue** and **exemplify** for his/her submission with clients and superiors in his/her career.
CO 6	**Discuss, compare, debate, judge** and **Criticize** others' presentations with confidence .

The students have to deliver a talk individually through power point presentation on technical topics, preferably related to mechanical engineering. The topic will be chosen by the students but subject to the respective teacher's approval. The topic should not be a part of the subjects already taught in the class. Score will be based on presentation and its defense, quality of the slides, and novelty of the topic and class attendance. The students have to submit a report on the seminar talk which will also carry marks.

[illegible]
09/08/2022

Course Name : FLUID POWER CONTROL					
Course Code: MECH 3131					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Relate the fundamental laws of fluid mechanics with fluid power and control systems.
CO 2	Identify the applications of the basic components in fluid power systems.
CO 3	Examine different types of pumps, actuators, valves and other components used in hydraulic and pneumatic circuits.
CO 4	Justify the use of different components in the fluid power control circuits.
CO 5	Demonstrate the applications of fluid power circuits.
CO 6	Investigate the performance of different fluid power control circuits.

Module	**Syllabus**	**Contact Hrs.**
1	**Fluid power:** Applications and advantages; Components of a hydraulic and pneumatic system. Desired properties of a working fluid; advantage of mineral oil over water; compressibility and incompressibility. Pascal's law; analysis of simple hydraulic jack, Mechanical advantage; continuity equation. Hydraulic Pumps: positive displacement pumps; constructional features, working principle and volumetric capacity of external gear pump, vane pump, axial piston pump and radial piston pump.	3 2 4
2	**Hydraulic Actuators :** (i) Constructional features of single acting and double acting hydraulic cylinders; mounting of cylinders, cushioning of cylinder; different application of cylinder through mechanical linkages; force, velocity and power from a cylinder. (ii) Hydraulic motors; torque, power and flow rate in a hydraulic motor. Hydraulic Valves: (i) Direction control valves – operation and graphical symbol of 3 way and 4 way valves; different modes of activation of valves; (ii) Operation and graphical symbols of check valves, pressure relief valve, pressure reducing valve,	5

	unloading valve and flow control valve.	4
3	**ANSI symbols for different hydraulic components. Analysis of hydraulic circuits for :** i) Single acting cylinder control. ii) Double acting cylinder control. iii) Regenerative circuit. iv) Pump unloading circuit. v) Double pump hydraulic system. vi) Cylinder synchronization circuit. vii) Speed control of a hydraulic motor. viii) Circuit to lift and hold heavy load. ix) Automatic sequencing of two cylinders.	9
4	Advantages & disadvantages of pneumatic system compared to hydraulic system; constructional details and operation of a reciprocating compressor; working principle and use of filter, pressure regulator, lubricator and silencer; symbols of different pneumatic components; compressed air distribution system in a plant; drawing pneumatic circuits for different operations. Use of electrical devices for controlling fluid circuits; function of electrical devices like push-button switches, limit switches, pressure switches, solenoids, relays and timers and their symbols; concept of ladder diagram; study of following circuits using electrical control devices : i) control of a solenoid actuated cylinder using one limit switch. ii) reciprocation of a cylinder using pressure or limit switches. iii) two cylinder sequencing circuit using two limit switches.	9
	Total Classes	**36**

Text Books:

1. Fluid Power with Applications- A. Esposito, 7e; Pearson.
2. Pneumatic Systems: Principles and Maintenance- S.R. Majumdar, Tata McGraw Hill.

Reference Books:

1. Introduction to Hydraulics and Pneumatics- Ilango and Soundararajan, 2e; PHI.
2. Fluid Power, Generation, Transmission and Control- Jagadeesha. T and Gowda T, 1e; Wiley Publication.
3. Fluid Power: Theory and Applications- James A. Sullivan, 3e; PHI.

09/08/2022

Course Name : REFRIGERATION & AIR CONDITIONING					
Course Code: MECH 3132					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

CO1	Differentiate between cooling and Refrigeration , Calculate refrigeration capacity, understand the nomenclature of various refrigerants, List various important properties of refrigerants and their impact on environment.
CO2	Understand how standard vapour compression cycle works, its various key components, their functions, Analyse different thermodynamic cycles , Calcualte COP of the SVCRs, Identify the limitations of single stage vapour compression refrigeration cycle and Understand the utility of Multi stage, multi evaporator system.
CO3	Understand Air Refrigeration system, its advantages and limitations, and its applications ,Understand how different types (Li – Bromide , Aqua-Ammonia) of Vapour absorption cycle operates, its advantages and disadvantages over VCRs, Calculate actual COP and theoretical max. COP.
CO4	Understand how different types of compressors work , List their advantages and disadvantages, Calculate Cylinder dimensions of reciprocating compressors, understand the utility of intercooler , List the advantages of multistage compression with or without inter cooling.
CO5	Understand the different types of condensers, expansion devices and evaporators used in various refrigeration systems, Calculate the Heat Rejection Rate , Critical charge and its importance on system performance .
CO6	Understand various properties of moist air, Read Psychrometric chart and collect data based on various psychrometric processes, Estimate the heating and cooling load calculations, Design ducts based on field requirement, Estimate ventilation load

Module	Syllabus	Contact Hrs.
1	**Introduction:** Concepts of Refrigeration and Air-conditioning, Unit of refrigeration, Refrigerants-Desirable Properties, Nomenclature. **Simple Vapour Compression Refrigeration System (Simple VCRS):** Vapour compression cycle on $p-h$ and $T-s$ diagrams, Cycles with subcooling, superheating and their effects; Effect of changes in evaporator pressure and condenser pressure on the performance of a simple VCRS. Multi-stage and multiple evaporator system, Cascade system, COP comparison. Dry compression and wet compression of refrigerant; Actual Vapour Compression Cycle.	2 3 2 2
2	**Air Refrigeration System (ARS):** Bell-Coleman refrigerator. COP determination, actual air refrigeration cycle. **Vapour Absorption Refrigeration System (VARS):** Advantages of VARS over VCRS, Working principle of simple VARS, practical VARS, Refrigerant-absorbent combinations. Limitations of VARS, Maximum COP of VARS, Lithium bromide-water System, Aqua-ammonia systems.	3 3 3
3	**Equipment and Control:** Major Refrigeration Equipment - Compressors: reciprocating, rotary & centrifugal, volumetric efficiency, Condensers: types used in refrigeration systems; Evaporators: expansion devices: capillary tubes and thermostatic expansion valves. **Air-conditioning equipment:** Airhandling units, Cooling Towers.	6 4
4	Basic definitions and principles related to Psychometry ; Psychometric Charts & Their Uses; Heating, Cooling, Heating & Humidification and Cooling & Dehumidification processes. Adiabatic Saturation, Cooling Coils, By-pass Factor. Sensible Heat Factors. Heat Load estimation: Simple cases of Cooling and Dehumidification. Ventilation: Definition & Requirements, Natural & Mechanical Ventilation, Ventilation Load Calculation, Duct Sizing & Design.	4 2 2

	Total Classes	**36**

Text Books:

1. Refrigeration and Air Conditioning- C.P. Arora, TMH, 3e.
2. Refrigeration and Air Conditioning- W.F. Stoecker & J.W. Jones, McGraw Hill.

Reference Books:

1. Refrigeration and Air Conditioning- R.C. Arora, PHI.
2. Basic Refrigeration and Air Conditioning- P.N. Ananthanarayanan, TMH, 3e.
3. Refrigeration and Air Conditioning- S.C. Arora and S. Domkundwar, Dhanpat Rai Publication.

09/08/2022

Course Name : ELECTRICAL MACHINES					
Course Code: MECH 3133					
Contact Hours per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes:

At the end of this course students will be able to

CO1: Acquire the knowledge of the constructional details and operating principle of DC generator and analyze the performance under various operating conditions to solve complex electrical engineering problems.
CO2:- Acquire the knowledge of the operating principle of DC motor and analyze the performance under various operating conditions to solve complex electrical engineering problems.
CO3: Identify and analyze the problems related to performance analysis of single phase transformer reaching substantiated conclusion.
CO4 Identify, formulate and solve the numerical problems related to three phase induction motor.
CO5: Acquire the knowledge of synchronous generator to identify and analyze the problems related to performance analysis.
CO6: Understand the knowledge of synchronous motor to solve complex engineering problems related to various applications.

Module I:-

Construction of DC machine. Different methods of excitation of DC machine. [1]

DC Generators:- EMF equation.Concept of armature reaction. Voltage build-up of shunt Generator. Characteristics of DC Generator. [3]

D.C. Motors:- Principle of operation. Back EMF. Torque equation. Characteristics of DC motors. Speed control of DC motor. Starting of DC shunt motor. Different methods of braking. [5]
Losses and Efficiency of D.C Machine . Application of D.C Machine [2]

Module II:-

Single phase Transformers:-Construction of Transformer. Operating principle of 1-ph transformer. Emf Equation. Equivalent circuit and Phasor diagram of ideal and practical transformer. Losses and efficiency-Open & short circuit tests. Voltage regulation. Parallel operation. [7]

ModuleIII :-

Three phase Induction Motor:-Construction. Production of rotating magnetic field. Working principle. Slip, frequency of rotor current, stator and rotor emf. Equivalent circuit and phasor diagram. Torque speed characteristic. Different methods of speed control. Methods of improving the starting torque. Different methods of braking of induction motor. Application of three phase Induction Motor. [7]

Module IV:-

Alternator:-Construction. Excitation Systems. E.M.F equation. Pitch factor and Distribution factor. Armature reaction- Lagging, Leading, Unity p.f load. Equivalent circuit and phasor diagrams. Voltage regulation- Open circuit and short circuit test. Use of salient pole and cylindrical rotor alternator. [5]

Synchronous Motor:-Principle of operation. Phasor diagram. Effect of varying field current- v curve, synchronous condenser. Starting of synchronous motor. Hunting. Application of synchronous motor. [4]

Special Machine:-Stepper Motor, Servo Motors (A.C and D.C), Universal motor. [2]

Text Books :	Reference Books :
1.Electrical Machinery by Dr. P.S. Bimbhra. 2.Electrical Machines by S. K. Bhattacharya 3. Electrical Machines by Ashfaq Hussain	1.Theory & Performance Of Electrical Machines By J.B.Gupta 2.Electrical Machines By Abhijit Chakarabarti And Sudipta Debnath.

Samar
09/08/2022

Course Name : FLUID POWER CONTROL LAB					
Course Code: MECH 3136					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	Identify the basic components of fluid power control systems.
CO 2	Apply the knowledge of engineering fundamentals to understand the working principle of different components used in fluid power control circuits.
CO 3	Build different circuits for actuator control and demonstrate the same.
CO 4	Investigate and calculate various useful parameters from the experimental readings with some knowledge on related errors in the experimental readings/setup/procedure/instruments.
CO 5	Justify the use of different fluid power control circuits for desired outcome.
CO 6	Perform effectively as an individual, and as a member of a team in a laboratory.

List of Experiments:

1. Study of a hydraulic trainer system.
2. Study of a pneumatic trainer system.
3. Controlling the speed of a hydraulic cylinder by operating a flow control valve.
4. Controlling the speed of a pneumatic cylinder by operating a flow control valve.
5. Prepare an ‘AND’ valve circuit using pneumatic components.
6. Prepare an ‘OR’ valve (shuttle valve) circuit using pneumatic components.
7. Operation and study of the function of a pressure reducing valve in a hydraulic circuit.
8. Design, preparation and operation of a hydraulic circuit for sequencing two hydraulic cylinders using a sequence valve.

N.B: A minimum of six experiments must be performed in the semester.

09/08/2022

Course Name : REFRIGERATION AND AIRCONDITIONING LAB					
Course Code: MECH 3137					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>Course Outcomes:</u>

CO1	Determination of cooling load from psychometric chart.
CO2	Evaluate the COP from p-h diagram.
CO3	Demonstrate the VCRS and calculate the theoretical and experimental COP.
CO4	Understand the different components of air refrigeration test rig and perform the theoretical and experimental COP.
CO5	Analyze the domestic refrigeration and calculate the various COP.
CO6	Understand the thermoelectric cooling system.

List of Experiments:

1. Determination of COP of a VCR system.
2. Determination of COP of a VAR system.
3. Study of a room (window type) Air Conditioner and determination of COP.
4. Determination of heat rejection by the condenser of Window air conditioner
5. Experiment in an Air Conditioning Test Unit; Determination of COP and plotting of the cooling – dehumidification process on a psychrometric chart.
6. Experiment in an Air Conditioning Test Unit; Determination of COP and plotting of the Heating – humidification process on a psychrometric chart.
7. Performance test of thermoelectric refrigeration system used as cooler.
8. Performance test of thermoelectric refrigeration system used as heater.

MECH 3138: ELECTRICAL MACHINES LAB

Contacts: 3P **Credit: 2**

List of Experiments:

1. To study the open circuit and short circuit tests of a single phase Transformer.
2. To study the speed control of a D.C shunt Motor.
3. To study the saturation characteristics of a D.C shunt Generator.
4. Speed control of D.C shunt Motor by ward-Leonard method.
5. To study the Speed-Torque characteristics of a Slip-ring Induction Motor.
6. To study the external load characteristics of a D.C Shunt Generator.
7. To study the open and short circuit characteristics of an Alternator.

09/08/2022

Course Name : FINITE ELEMENT METHOD					
Course Code: MECH 3142					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of this course students will be able to

CO1	Understand the transformation of the solution methodology of Governing Equation of any physical phenomenon from its analytical approach to a numerical approach like method of Finite Element Analysis (FEA).
CO2	Justify the expressions of Shape Functions of different 1D elements like (BAR, BEAM and FRAME) used for solving any physical problem numerically with 1D topological consideration through energy method like PSTP and Rayleigh-Ritz method.
CO3	Implement 1D elements like BAR element, BEAM element and FRAME element correctly in accordance with the Boundary conditions and Loading conditions of a particular problem to solve numerically using FEA method.
CO4	Justify 'Plane Stress' approach and 'Plane Strain' approach to solve any physical problem numerically using FEA method with 2-Dimensional elements like 'TRIA' and 'QUAD' for 2-Dimensional topological consideration.
CO5	Use 'Normalized Co-ordinate System' in place of 'User Co-ordinate System' in solving a physical problem numerically using FEA method with 2-Dimensional topological consideration using 2-Dimensional elements.
CO6	Justify the method of operation of steps of operation of any FEA software like MSC Software, ANSYS etc using computer as working or solving media.

.

Module	**Contents**	**Contact Hrs.**
1	**Introduction:** Historical background, FEM application on design problems, Concept of governing Equations for continuum, Solution of Governing Equation using Galerkin method, Weighted residual and Weak form method, Piece wise continuous trial function solution of weak form, Concept of Shape Function and Element stiffness matrix, Principle of Stationary Total Potential (PSTP) (Ritz Method), Coordinates and Shape Function	10
2	**One Dimensional Problem:** The Potential Energy Approach to find Element Stiffness Matrix of BAR Element, FEA formulation and understanding of Boundary Condition terms and Force Terms, Shape	8

	function and Stiffness Matrix of Quadratic BAR Element and BEAM element,	
3	**One Dimensional Problem (contd):** Concept of FRAME Elements. Assembly of elements and Technique of Stiffness Matrix Globalization, Solving 2-Dimensional Truss Problems. **Two Dimensional Problem:** Dimensionality of a Problem, Overview about different Two Dimensional elements and their geometrical approximation, CST element (Iso-parametric Representation, Potential Energy Approach, Element Stiffness; Basic concept of Jacobian Method, Numerical integration of Two Dimensional Iso-parametric Elements.	10
4	**Two Dimensional Problems (contd):** Stress Calculation and Heat Transfer problems. **Computer implementation:** Pre-processor, Processor, Post-processor. Discussion about finite element packages.	8
Total Classes		**36**

Text Books:

1. Introduction to Finite Elements in Engineering by T.R. Chandrupatla and A.D. Belegundu, Prentice Hall of India.
2. A Text Book of Finite Element Analysis by P Seshu, PHI Learning Pvt. Limited.
3. Concepts and Applications of Finite Element Analysis by R.D. Cook, D.S. Malkus and M.E. PleshaPrentice Hall-India, NewDelhi.

Reference Books:

1. Finite Element Analysis by C.S. Krishnamoorthy, TMH.
2. Finite Element Procedures by K-J. Bathe, Prentice Hall.
3. The Finite Element Method: Its Basis and Fundamentals by O.C. Zienkiewicz, R.L. Taylor, J.Z. Zhu, Elsevier.
4. An Introduction to the Finite Element Method by J.N. Reddy, McGraw-Hill.

09/08/2022

Course Name : TURBO MACHINERY					
Course Code: MECH 3143					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completion of the course, the students will be able to:

- Classify different types of turbo machines.
- Understand the basic working principle of different types of turbo machines.
- Identify different losses in turbo machines.
- Select an appropriate class of turbo machine for a particular application.
- Analyze different performance characteristics of various turbo machines.
- Differentiate between fans, blowers & compressors.
-

Module No.	Syllabus	Contact Hrs.
1	**Introduction**: Definition, Classification and Application of turbo machines. Incompressible and compressible flow turbo machines. Radial, Axial and Mixed flow type machines. Basic equation of energy transfer in turbo machines. Comparison of turbo machines with positive displacement machines; Similarity and model study in turbo machines; dimensional analysis of incompressible flow turbomachines; unit and specific quantities, non-dimensional parameters and their significance; effect of Reynolds number, specific speed. Installation losses of turbo machines.	2 7
2	**Pump:** Classification, Main components and their functions. Velocity diagram; Different heads and efficiencies for centrifugal pump. Priming in centrifugal pump. Multi stage of pump, influence of vane exit angle on head capacity & power capacity relationship, slip factor, pump losses and efficiencies; minimum speed of pump to deliver liquid; overall design considerations of pump; similarity relations and specific speed, selection of pump, cavitation and NPSH, horizontal and vertical pump, bore hole pump/ deep well pump / submersible pump.	9
3	**Hydraulic Turbines:** Classification, main components and their functions; degree of reaction, comparison between impulse and reaction turbines; design aspects of Pelton wheel, Francis and Kaplan turbines; model and selection of turbine: models and their testing, similarity considerations, relation between the characteristics data of a turbine and that of its model; governing of water turbine; water conveyance system and surge tank.	9

4	**Compressible flow machines:** Introduction: comparison among fans, blowers & compressors; classification and applications; set up and operating characteristics of fans, blowers & compressors. **Centrifugal Compressor**: Introduction, elements of centrifugal compressor, Work done and pressure rise, inlet duct impeller, pre-whirl vanes, Diffuser design, Choking, Overall pressure ratio developed; losses in centrifugal compressor. **Axial flow compressor**: Axial compressor characteristics, compressor staging, flow through stages, velocity triangles, pressure ratio developed per stage – work done factor.	9
Total Classes		**36**

Text Books:

1. Introduction to Fluid Mechanics and Fluid Machines- Som, Biswas and Chakraborty, TMH, 3e.
2. Hydraulic Machines- Dr. Jagdish Lal, Metropolitan Book Co. Pvt. Ltd, Reprint 2011.
3. Mechanics of Fluids- B Massey, Taylor & Francis, 8e.

Reference Books:

1. Fluid Mechanics and Machinery- C.S.P Ojha, R. Berndtsson, P.N.Chandramouli, OUP, 1e.
2. Turbomachinery: Designed and theory- Gorla, Taylor & Francis (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011.
3. Incompressible Flow Turbomachines- Rowal, Elsevier (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011.
4. Principle of Turbomachinery- Turton R. K, Springer (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint 2011.
5. Turbomachines- B.U.Pai; WILEY, 1e, 2013.

09/08/2022

Course Name : NEW PRODUCT DEVELOPMENT					
Course Code: MECH 3144					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Understand the opportunities and challenges of new product development working in a team.
CO 2	Develop concept of Reverse engineering and redesign methodology.
CO 3	Familiarization with legal and ethical issues in Product development.
CO 4	Assess market demand, develop broad outline of the product and work out its profitability.
CO 5	Prepare detailed product architecture and product costing.
CO 6	Set final product specification taking into account its manufacturability, prototype making and validation for real life products.

Module	Syllabus	Contact Hrs.
1	**Introduction:** Need for the new product development; Product development Process: understand opportunity, develop concept, implement concept of Reverse engineering & redesign methodology; Development Vs design; Product development team; Product development planning; Legal and ethical issues in product development; case studies.	**10**
2	**What to Develop:** 'S' curves and technical forecasting; Market demand assessment; Customer needs and satisfaction; Product function and FAST (function analysis system technique) method. Volume and profit breakdown; Estimating project facility cost and ROI.	**8**
3	**Product Architecture:** Integral and modular architecture; types of modularity; Modular design : Clustering method and functional method; Generating concepts/ value engineering: brain storming, direct search, morphological analysis; Product costing; case studies.	**8**
4	**Design Process:** Bench marking process steps; Setting product	**10**

	specifications; Design for manufacture, assembly and disassembly; maintenance, quality and usability; Prototype making and validation; Casus of new product failure; Case studies.	
	Total Classes	**36**

Note to the Teachers: Sufficient number of case studies should be cited and discussed during teaching the subject.

Text Books:

1. Product Design: Technique in Reverse Engineering and New product Development- K.Otto and K.Wood, Pearson Education.
2. Product Development- Anil Mital et al, Elsevier, 2008.
3. New Product development- M.A. Annacchino, Elsevier, 2003.

Reference Books:

1. Engineering Design by George E. Dieter, McGraw Hill, International Editions, 3rd Ed.

09/08/2022

Course Name : TOOL ENGINEERING					
Course Code: MECH 3145					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of this course, students will be able to:

- Select different materials for manufacturing various tools.
- Learn design features of various types of tools used in Manufacturing Industry.
- Explain various tool making practices.
- Design Jigs and fixtures for various work holding and machining situations.
- Design Inspection Gauges.

Module No.	Syllabus	Contact Hrs.
Module 1	**Introduction:** Concept of Tool Design and Manufacturing, its importance in Manufacturing Industry. Fundamentals of Cutting and Forming tools. **Tool Materials**: Work hardening Tool Steels, Shock Resisting Tool Steels, Cold-Work Tool Steels, Hot-Work Tool Steels, High Speed Tool Steels, Non-ferrous Tool Materials- Cemented Carbide, Coated Carbide, Non-Metallic Tool Materials- Ceramic, Cubic Boron Nitride (CBN), Polycrystalline Diamond (PCD).	**4** **5**
Module 2	**Manufacturing tools:** Drills, Milling Cutters: Profile sharpened Milling Cutters, Form relieved Milling Cutters, Inserted blade Cutters, Gear tooth Milling Cutters, Gear Hobs, Gear shaping Cutters; Press tools.	**9**
Module 3	**Tool Manufacturing:** Blank Preparation, Machining locating datum surfaces, Manufacturing body of cutting tool, Marking of cutting edge, Sharpening and lapping. Punch and Die Manufacture, Tracer and Duplicating Mills for cavity applications, EDM for cavity applications. Production of carbide tools.	**4** **4** **1**
Module 4	**Jigs & Fixtures:** **Drill Jigs:** Introduction, Types of Drill Jigs, Drill Bushings, and Methods of construction. **Fixtures:** Introduction, Types of fixtures, Milling, Boring, Lathe and Grinding fixtures. **Inspection Gauges:** Introduction, Fixed gauges, Gauge tolerances,	**3** **3** **3**

	Material selection, Methods of construction.	
	Total	**36**

Text Books:

1. Tool Design, C. Donaldson and V. C. Goold, TMH Publication.

Reference Books:

1. Fundamentals of Tool Design, Jeff Lantrip, John G. Nee, and David Alkire Smith, Society of Manufacturing Engineers.

09/08/2022

Course Name : INDUSTRIAL ROBOTICS					
Course Code: MECH 3146					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>Course Outcomes:</u>

On completion of this course, students will be able to:

- Learn basic concept of Robotics and its capabilities.
- Define and formulate kinematics of robots.
- Select end effectors, actuators and sensors used in robots.
- Specify a robot for industrial application.
- Write program for a robot.

Module No.	Syllabus	Contact Hrs.
Module 1	Introduction: Brief history of robotics; definition of robot; Main components of robot, Robot geometry: types of joints, workspace, number of degrees of freedom; Common configurations used in arms: rectangular, cylindrical, spherical, jointed; Classification of robot according to coordinate system: Cartesian, cylindrical, polar, articulated or jointed; Classification of robots according to control method: non-servo, servo; Robot specifications.	**3**
	Robot Kinematics: Definition of Robot kinematics, Tool frame and base frame. World – coordinate system, Direct kinematics, Inverse kinematics, Position and orientation of objects, Homogenous transformation, Denavit-Hartenberg (D- H) representation.	**7**
Module 2	Robot End Effector: Definition, gripper, tools; Types of grippers: mechanical grippers, vacuum cups, magnetic grippers, adhesive grippers; Robot Tools: Spot welding gun, pneumatic wrench, welding torch, grinder, spray painting gun.	**4**
	Characteristics: Power to weight ratio, Stiffness, Compliance, Reduction gears; Conventional actuators: Hydraulic actuator, Pneumatic actuator, Electric motor: DC motor, Stepper motor, Servo motor; Special actuators: Magnetostrictive, Shape memory alloy, Elastomeric.	**4**
Module 3	Robot Sensors: Basic categories of sensing devices: analog, digital; Types of sensors: tactile and non-tactile; position, velocity, acceleration, force, pressure, torque, slip, and proximity. Robot Vision System: definition, use, functions, components, classification; Application of robot vision system.	**8**
Module 4	Robot Programming: Different methods of robot programming: teach-pendant	**8**

	programming, key board programming; Programming languages: VAL II, AML/2, ARM BASIC	
	Industrial applications: Welding, Spray painting, Grinding; Machine loading and unloading, Assembly operation; Inspection.	**1**
	Special applications: Underwater prospects and repairs, Mining, Space Exploration, Surgery.	**1**
	Total	**36**

Text Books:

1. Industrial Robotics: Technology, Programming and Applications, Mikell P. Groover, Mitchell.Weiss, Roger N. Nagel, Nicholas G. Odrey, McGraw-Hill International Edition.
2. Robotics Technology and Flexible Automation, S.R. Deb, Tata McGraw-Hill Publication.
3. Robotics for Engineers, Koren, Yoram, McGraw-Hill Book Company, Singapore.

Reference Books:

1. Robotic Engineering:An Integrated Approach, Klafter, Richard D. Chmielewski, Thomas A. and Negin, Michael (2001), Prentice-Hall of India Pvt. Limited.
2. Introduction to Robotics: Analysis, Systems, Applications, Niku, Saeed B., Prentice Hall of India Private Limited, New Delhi.
3. A Textbook on Industrial Robotics, Hegde, Ganesh S., Laxmi Publications (P) Ltd.

09/08/2022

MECH 3201: I C ENGINES

Contacts: 3L **Credits: 3**

Course objectives:

After going through the course, the students will be able to:

- Calculate the work output and thermal efficiencies of engines working with Otto/Diesel/Dual combustion cycle.
- Understand and quantify the differences in work outputs between theoretical cycles and actual cycles in operation.
- Compare the differences between combustion processes in SI and CI engines and accordingly appreciate the characteristics of fuels.
- Make a quantitative analysis of air-fuel ratio in a simple carburetor.
- Understand ignition system in an SI engine.
- Analyze the requirement of heat transfer with cooling.
- Learn the various performance testing procedures and estimate IHP, BHP, FHP and efficiency parameters.
- Analyze an ideal gas turbine cycle and calculate thermal efficiency and work output.

Module	Syllabus	Contact Hrs.
1	**Heat engines:** Working principle of 2-stroke and 4- stroke IC engines. Basic engine components and nomenclature; First law analysis of engine cycle; Nomenclature of various engine parameters.	2
	Analysis of air standard cycles: Otto cycles, Diesel cycles and dual combustion cycles; comparison; Other cycles: Carnot, Stirling, Erricsson, Lenoir, Atkinson, Brayton cycles; numerical problems.	3
	Analysis of fuel- air cycles: significance; effects of variable specific heat, composition of gases, dissociation, number of moles; numerical problems; Analysis of actual cycles with respect to factors of time loss, heat loss and exhaust blowdown.	4
2	**Fuels**: Gaseous and liquid fuels; Desirable characteristics of I.C. engine fuels; Rating of S.I. and C.I. engine fuels; HCV and LCV of the fuels	2
	Fuel- air mixing in S.I. engines: Volumetric efficiency, concept of supercharging, working principle of a simple carburetor; Analysis of simple carburetor; Numerical problems.	4
	Combustion of fuels in I.C. engines: Stages of combustion in SI and CI engines; flame front propagation; factors influencing combustion; knocking / detonation and their preventions.	3

3	Mechanical injection systems in C I engines: Principles of different injection systems; Fuel feed pump, injection pumps; Fuel injector and nozzles; Quantity of fuel and size of nozzle orifice; Numerical problems; Basic principles of MPFI in SI engines.	4
	Ignition in S I engine: Requirement of an ignition system; Battery ignition system with different components; ignition timing and spark advance; Reference to other ignition systems.	3
	Lubrication system in I.C. engines: Losses and requirement of lubrication; Different systems; Properties of lubricating oil.	2
4	Cooling system in I.C. engines: Temperature distribution and heat transfer; Principles of liquid cooled and air cooled	2
	Performance and testing of I.C. engines: Engine power; Engine efficiencies; Engine performance characteristics. Measurement of speed, torque, fuel consumption, determination of IHP, BHP and FHP, sfc, different efficiencies; plot of efficiency vs. speed curves, numerical problems	3
	Engine emissions and their control: Different exhaust and non-exhaust emission, relation with equivalence ratio; Emission control methods	2
	Introduction to Gas Turbine: Open cycle/ closed cycle gas turbine; Analysis of simple ideal gas turbine cycle; real gas turbine cycles with isentropic efficiencies, numerical problems	2
	Total Classes	**36**

Text Books:

1. Internal Combustion Engines- V. Ganesan, Tata McGraw-Hill Companies.
2. A course in Internal Combustion Engines - M.L. Mathur and R.P. Sharma, Dhanpat Rai & Sons.
3. Fundamentals of Internal Combustion Engines- H.N. Gupta, PHI Learning Private Ltd.

Reference Books:

1. Fundamentals OF IC Engines by Paul W Gill , Oxford &IBH-Pubs Company- New Delhi.
2. Gas Turbines- V. Ganesan, Tata McGraw-Hill Companies.
3. Internal Combustion Engine and Air Polution - Obert, Edward Frederic.
4. Internal Combustion Engines; Applied thermo sciences- Colling R Farguson, Allan T, Kirkpatrick, Willey Publication, 3e.
5. Internal Combustion Engine Fundamentals -John B Heywood, Mc-Graw Hills.

09/08/2022

Course Name : MACHINING PRINCIPLE & MACHINE TOOLS					
Course Code: MECH 3202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Acquire knowledge on basic principle and purpose of machining.
CO 2	Familiarization with tool geometry and to designate a single point cutting tool.
CO 3	Analyze mechanism of machining, mechanics of machining and determine time of machining.
CO 4	Learn tool failure mechanisms, assess tool life and select an appropriate cutting tool material for a particular application.
CO 5	Learn the use of different power drives, gear layout, gear box etc. and kinematic structure of different machine tools.
CO 6	Appreciate principles and applications of CNC machine tools.

Module	Syllabus	Contact Hrs.
1	**Ia. Introduction:** Machining: Basic principle, purpose, definition and requirements.	1
	Ib. Geometry of cutting tools: 1. Geometry of single point turning tools in ASA and ORS systems. Significance of rake and clearance angles.	1
	2. Conversion of tool angles from one system to another by graphical methods.	2
	3. Geometry of drills and milling cutters.	1
	Ic. Mechanism of machining: 1. Chip formation mechanism, yielding and brittle fracture, chip reduction coefficient, cutting ratio, shear angle and cutting strain.	1
	2. Built-up edge formation, cause, type and effects, orthogonal cutting and oblique cutting.	1
	3. Machining chips: types and conditions, chip formation in drilling and milling.	1
2	**IIa. Mechanics of machining:** 1. Purposes of determination of cutting forces and basic two approaches, cutting force components in orthogonal cuttings and merchant's circle diagram. 2. Determination of cutting forces, analytical methods, measurement. 3. Dynamometers, construction and working principles of strain gauge	3

	type and piezoelectric crystals type turning, drilling dynamometers. **IIb. Cutting temperature:** 1. Heat generators and cutting zone temperature, sources, courses and effects on job and cutting tools, role of variation of the machining parameters on cutting temperature. 2. Determination of cutting temperature by analytical and experimental methods. 3. Control of cutting temperature and application of cutting fluids (purpose, essential properties, selection and methods of application). **IIc. Cutting tools-failure, life and materials:** 1. Methods of failure of cutting tools mechanisms, geometry and assessment of tool wear. 2. Tool life, definition, assessment and measurement, Taylor's tool life equation and it's use. 3. Cutting tool materials, essential properties, characteristics and applications of HSS, carbide (uncoated/coated), ceramic, diamond and CBN tools; carbide tool inserts & tool holders. **IId. Grinding:** 1. Modes and mechanisms of chip formation, selection and application. 2. grinding forces, surface roughness and wheel life.	3 5
3	**IIIa. Machine tools – Introduction:** 1. Purpose of use , definition and general features of machine tools. 2. Generatrix and Directrix and tool – work motions in different operations of conventional machine tools. **IIIb. Machine tool classification:** Broad classification of machine tools. **IIIc. General constructional features and functions of machine tools :** 1. Major components and their functions in lathes ; shaping , planning and slotting machines ; drilling machines and milling machines, capstan and turret lathes. 2. Machining operations and application of the common machine tools and their way of specification. **IIId. Kinematic structure of machine tools:** 1. Types of kinematic structures and diagrammatic representation. 2. Kinematic structure of centre lathe & shaping machine.	2 1 3 3

4	**IVa. Machinability and machining economics:** 1. Machinability: definition, assessment, improvement and evaluation of optimum cutting velocity and toll life.	1
	IVb. Control of speed and feed of machine tools : 1. Need of wide ranges of speeds and feeds, machine tool drive. 2. Design of speed, gear box, speed layout, ray diagrams, gear layout, gears and spindle. 3. Control (selection and change) of feed in centre lathes and hydraulically driven machine tools.	4
	IVc. Machining time : 1. Estimation of time required for various operations like turning, drilling , shaping and milling.	1
	IVd. Computer numerical controlled machine tools : 1. NC and CNC system; purpose, principle, advantages, limitations and application in machine tools.	2
	Total Classes	**36**

Text Books:

1. Machining and Machine Tools- A.B. Chattopadhyay, Wiley India (P) Ltd., New Delhi.
2. Principles of Metal Cutting- G. Kuppuswamy, University Press, Hyderabad.
3. Metal Cutting Principles and Practices- M.C. Shaw, Oxford University Press.

Reference Books:

1. Metal Cutting Theory and Practice- Stephenson & Agapion, Taylor and Francis, NY.
2. Principles of Machine Tools- G.C. Sen and A. Bhattacharyya, New Cantral Book Agency (P) Ltd., Kolkata.
3. Machine Tool Design- Acharkan, Vol. I, II, III and IV, Mir Publication, Moscow.

09/08/2022

Course Name : APPLIED THERMODYNAMICS & HEAT TRANSFER LAB					
Course Code: MECH 3212					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Understand a combined separating and throttling calorimeter and determine the dryness fraction of a steam sample by using the mentioned calorimeter.
CO 2	Evaluate the thermal conductivity of a cylindrical metallic rod using the technique of least square method.
CO 3	Comprehend the fundamentals of thermal conduction in spherical geometry and measure thermal conductivity of an insulating powder.
CO 4	Study a shell and tube heat exchanger for the determination of log-mean temperature difference and effectiveness of the heat exchanger.
CO 5	Estimate the convective heat transfer coefficient for forced convection over a cylindrical fin and plot the spatial variation of temperature along the fin.
CO 6	Learn the basic terminologies related to thermal radiation and assess the emissivity of a gray body.

List of Experiments:

1. Determination of dryness fraction of steam by a combined separating and throttling calorimeter.
2. Determination of thermal conductivity of a metal rod.
3. Determination of thermal conductivity of an insulating powder.
4. Study of a shell and tube heat exchanger for determination of LMTD and calculation of effectiveness.
5. Determination of local heat transfer coefficient (h) for forced convection over a cylindrical fin and temperature plotting.
6. Determination of emissivity of a grey body.
7. Determination of the Natural Heat Transfer Co-efficient in a heated vertical cylinder.
8. Determination of Convective Heat Transfer Co-efficient with the use of Transient Heat Conduction.

09/08/2022

Sessional

MECH 3221: SEMINAR – II

Contacts: 3 P **Credits: 2**

This seminar presentation will be prepared and presented by a group consisting 4/5 students, based on a topic to be assigned by the Department. The seminar presentation will be evaluated by a group of senior faculty members, based on depth of understanding of the topic, quality of presentation, its defense and report; to be submitted after presentation.

09/08/2022

Course Name : MECHATRONICS					
Course Code: MECH 3252					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Learn the basic idea of a Mechatronics system
CO 2	Apply mechanical engineering knowledge to problems in the areas of Mechatronics engineering.
CO 3	Acquire knowledge on hydraulic drives, pneumatic drives and electrical drives used in Mechatronics System.
CO 4	Familiarise with analog and digital control systems.
CO 5	Know the operational principle of a microcontroller and its programming.
CO 6	Learn the basics of the PLC system and its application in Mechatronics system.

Module	Syllabus	Contact Hrs.
1	**Mechanical:** Introduction, Mechanical Drives: Different mechanisms, Ball screws, Linear motion bearings, Transfer systems. **Pneumatic and Hydraulic Drives:** Elements of pneumatic and hydraulic drives, comparison between them. Design of pneumatic and hydraulic circuits, symbolic representations of such circuits indicating different valves, actuators, etc. **Electrical Drives:** Stepper and Servo motors.	8
2	**Analog:** Review of negative feedback control, Op-amp- Review of inverting and non-inverting amplifier, Adder, Subtractor, Differential amplifier, Comparators, Schmitt trigger, Astable and Monostable multivibrators.	8
3	**Digital:** Review of number systems (+ve and –ve number representation), Digital codex (BCD, GRAY, XS3, and ASCII), Digital GATES (AND, OR, NOT, NAND, NOR, XOR, and XNOR), Concept of Decoder and Encoder, Concept of Multiplexer and Demultiplexer, Flip-flops and Registers, Counters and shift registers, Analog to Digital and Digital to Analog converter.	10
4	**Microcontroller:** Introduction, Instruction set, Programming in Assembly and C language, Ports, Counters, Interrupts, Design of microcontroller based circuits, **PLC:** Introduction to PLC.	10
	Total Classes	**36**

Text Books:

1. Mechatronics- N.P. Mahalik, Tata McGraw Hill Publication
2. Mechatronics- W. Bolton, Pearson Education
3. Mechatronics- A. Smaili and F. Arnold, Oxford University Press, Indian Edition
4. Mechatronics- M.D. Singh and J.G. Joshi, Prentice Hall of India Pvt. Ltd.

Reference Books:

1. Digital principles and applications- Albert Paul Malvino, Donald P. Leach, McGraw Hill.
2. The 8051 Microcontroller based embedded systems- Manish. K. Patel, McGraw Hill.
3. Microcontrollers: principles and applications- Ajit Pal, PHI
4. Mechatronics- HMT Ltd., Tata McGraw Hill Publication 8.

09/08/2022

Course Name : ADVANCED FLUID MECHANICS					
Course Code: MECH 3253					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Understand fundamental physical and analytical principles of ideal fluid flow.
CO 2	Analyze the mechanics of potential flow.
CO 3	Solve standard bench mark problems like Couette flow, annular flow etc.
CO 4	Apply the fundamental laws to solve problems of compressible fluids in engineering systems.
CO 5	Differentiate between the effects of drag and lift force on submerged bodies.
CO 6	Explain the basic principle of flow dynamics past an aerofoil

Module	Syllabus	Contact Hrs.
1	**Ideal Fluid Flow and flow kinematics:** Velocity potential function and stream function, equipotential line, relation between stream function and potential function.	2
	Circulation and vorticity; Vortex flow: forced and free vortex flow, equation of motion for vortex flow.	3
	Important cases of potential flow: uniform flow, source flow, sink flow, free vortex flow, super imposed flow (source and sink pair, doublet, flow past a half body, source and sink pair in a uniform flow, doublet in uniform flow)	4
2	**Viscous Laminar Flow of Incompressible Fluid:**	
	Flow between parallel surfaces: Couette flow and plane Poiseuille flow.	3
	Flow between concentric rotating cylinders.	2
	Laminar boundary layer equation through scale analysis- Prandtl boundary layer equation, Blasius flow over flat plate and shooting technique.	4
3	**Compressible Flow:** Compressible Flow: speed of propagation of a small disturbance through a compressible fluid, sonic velocity, Mach number, Mach cone and Mach wave; isentropic flow, stagnation properties of a compressible flow, isentropic pressure, temperature and density ratios;	9

	compressibility correction factor in the measurement of air speed; area – velocity relationship for compressible flow through a variable area duct, mass flow rate through a duct, maximum mass flow rate through a duct, critical condition and choking; flow through convergent-divergent nozzle.	
4	**Flow of fluid around submerged bodies:** drag on a sphere and cylinder; development of lift on a circular cylinder(both stationary and rotating). Expression of lift coefficient for rotating cylinder, location of stagnation point for a rotating cylinder in a uniform flow field, Magnus Effect. Development of lift on an aerofoil.	8 1
Total Classes		**36**

Text Books:

1. Introduction to Fluid Mechanics and Fluid Machines- Som, Biswas and Chakraborty, TMH, 3e.
2. Advanced Engineering Fluid Mechanics - K. Murlidhar & G. Biswas, Narosa Publication, 2e.

Reference books:

1. Fluid Mechanics- Kundu, Cohen & Dowling, Academic Press (Elsevier), 5e.
2. Engineering Fluid Mechanics- Graebel. W. P, Taylor & Francis (Yes Dee Publishing Pvt. Ltd), 1st Indian reprint, 2013.
3. Fundamental Mechanics of Fluid- I.G. Currie, 3e, Marcel Dekker, Inc./McGraw-Hill.

09/08/2022

Professional Elective –III Lab

Course Name : DESIGN PRACTICE-II LAB					
Course Code: MECH 3256					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

On completion of this course students will be able to

CO1	Implement as well as understand different international codes like ASME codes, AGMA codes, ISO codes etc. when they will be encountering with industrial drawings in their professional life.
CO2	Understand about a detailed methodology of design validation or modification done in industry or in research work numerically using any FEA software like MSC Software or ANSYS etc.
CO3	Use different tools of any FEA software like MSC Software or ANSYS when they will be taking part in any R-n-D activity regarding Structural analysis and/or Thermal analysis and/or Couple Field (Thermo-Mechanical) analysis.
CO4	Take active part in design activity regarding designing of shaft or equivalent machine components where ASME codes are used extensively in detail and also FEA software is used for design calculations and validations.
CO5	Engage themselves fruitfully in the process of any power driving system design like designing of Gear Drive and/or Pulley Drive and/or Cam Drive etc. where AGMA and ASME codes are used as well as FEA Software are used.
CO6	Understand design process of a Thermo-Mechanical system like designing of pressure vessel etc. where ASME as well as TEMA codes are used along with FEA software for the design validation.

Experiment/ Study	Topics	Contact Hrs.
1	**Introduction:** A over view about different design standards like AGMA (American Design Manufacturing Association) standard for Gear design, ASME (American Society for Mechanical Engineers) for Pressure Vessel Design, ISO (International Standardization Organization).	6
2	A Detailed discussion on methodology of solving a structural problem using FEA software MSC Patran and Nastran or equivalent software.	6
3	A Detailed discussion on methodology of solving a thermal problem using FEA software MSC Patran and Nastran or equivalent software.	3
4	**Design of shaft and bearing assembly:** ➢ Identification of loads and boundary conditions for a shaft which is to be designed and to be assembled between to roller bearings. ➢ Design of shaft and selection of bearings as per identified load and boundary conditions. Designing of shaft will be done complying ASME and ISO standards. ➢ 3-Dimensional modeling of shaft, bearing and assembly of shaft and bearing in a 3-D modeling software named PTC Creo Parametric 3.0 ➢ Numerical validation of the design using a FEA software like MSC Nastran or equivalent software.	9
5	**Design of a simple spur gear assembly:** ➢ Identification of required input data from the problem definition. ➢ Calculations for module and other constructional parameters of the spur gear following AGMA standard. ➢ Parametric modeling of the gears and their assembly using a 3D modeling software named PTC Creo Parametric 3.0 or equivalent software. ➢ Numerical validation of the design using a FEA software like MSC Nastran or equivalent software.	6
6	**Design of a pressure vessel:** ➢ Identification of required input data from the problem definition. ➢ Calculation of plate thickness for autofritage condition following ASME code. ➢ Parametric modeling of pressure vessel using a 3D modeling software named PTC Creo Parametric 3.0 or equivalent software. ➢ Numerical validation of the design using FEA software like MSC Nastran or equivalent software.	3
7	Determination of critical speed of a shaft using dynamic module of any FEA soft ware like MSC Nastran or equivalent software.	3
	Total	**36**

Recommended Books:

1. Mechanical Component Design- Robert C Juvinall and Kurt M Marshek. Published by Wiley Publication, 5th Edition 2012.
2. Mechanical Design of Machine Elements and- Jack A Collins, Henry Busby and George Staab. Published by ‘Wiley Publication’, 2nd Edition, 2010.
3. ISO Codes: All parts of ISO 6336.
4. AGMA Codes: AGMA 901/908/913/917/918/923/933, ANSI/AGMA- 2004 and ANSI/AGMA-2012.
5. ASME Codes: BPVC Section I- Rules for Construction of Power Boilers and BPVC Section IV-Rules for Construction of Heating Boilers.

09/08/2022

Course Name : MECHATRONICS LABORATORY					
Course Code: MECH 3257					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Familiarise with analog and digital circuit components.
CO 2	Understand the physical principles of different analogue and digital sensors and measure load, linear displacement and anguler displacement using sensors.
CO 3	Operate and control of DC motor / AC motor / Stepper motor.
CO 4	Analyse the basic concepts and programming of 8051 microcontroller
CO 5	Develop PLC programs for control of conveyor belt.
CO 6	Develop pneumatic and hydraulic circuits using trainer kit.

Experiment No.	**Experiment**
1	To study a strain gauge type load cell and measure load using such sensor.
2	To study the working principle of a force sensing resistor (FSR)/ pressure dependent resistor (PDR) and measure load with the help of FSR/PDR.
3	To study the constructional features & working principle of an LVDT and measure linear displacement using LVDT.
4	To study the characteristics of light dependent resistor and measure distance using such sensor.
5	To study the working principle of ultrasonic proximity sensor and measure distance using such sensor.
6	To study the working principle and application of inductive type proximity sensor.
7	To study the working principle and application of an infrared proximity sensor.
8	To study the angular position control of a D.C. servo motor and to measure angular position.

9		To study and determine the torque - speed characteristics of D.C. servo motor
10		To study the construction and working principle of three phase induction motor and control the speed by controlling the supply frequency
11		To study and run an Assembly language program (or Hex Code) in AT 89C51 / 52 microcontroller.
12		To study a hydraulic circuit involving different components to operate hydraulic actuators and limit control units.
13		To study a pneumatic circuit involving different components to operate pneumatic actuators and limit control units.
14		To study a Programmable Logic Controller (PLC) and to operate a D.C. motor driven conveyer belt unit using a PLC program.

Course Name : ADVANCED FLUID MECHANICS LAB					
Course Code: MECH 3258					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	Identify the basic components used in different fluid flow systems.
CO 2	Apply the knowledge of engineering fundamentals to understand the viscous fluid flow in pipelines and associated losses.
CO 3	Investigate the effect of design and off-design conditions for centrifugal pumps.
CO 4	Investigate the characteristics of open channel flow.
CO 5	Investigate and calculate various useful parameters from the experimental readings with some knowledge on related errors in the experimental readings/setup/procedure/instruments.
CO 6	Perform effectively as an individual, and as a member of a team in a laboratory.

List of Experiments:

1. Verification of Stokes' Law.
2. Study of minor losses in pipe fittings apparatus.
3. Determination of cavitation parameters of a centrifugal pump.
4. Performance test of centrifugal pumps in parallel operation.
5. Performance test of centrifugal pumps in series operation.
6. Performance test of submersible pump.
7. Study of characteristics of hydraulic jump.
8. Study of an open circuit wind tunnel.

09/08/2022

Course Name : MAINTENANCE ENGINEERING					
Course Code: MECH 3261					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After going through the course, the students will be able to:

CO1: **Understand** the difference between repair and maintenance, **Classify** different types of maintenance and their applicability.

CO2: **Appreciate** the importance of implementing TPM in an organization**, List** out the common factors between TPM and TQM and **Prioritize** actions based on Pareto analysis.

CO3:**Compute** overall equipment effectiveness, reliability and maintainability of different machines and **Decide** if a machine due for replacement .

CO4 : **Design** a Maintenance organization chart based on the type of business , **Prepare** a maintenance budget and Initiate maintenance audit procedure .

CO5 : **Understand** the importance of lubrication , **List** out the most economic method of lubrication, **Guide** common repairs job.

CO 6 :**Select** common types of general maintenance tools and equipment , **Choose** appropriate NDT methods to detect cracks .

Module	Syllabus	Contact Hrs.
1	**Introduction:** Definitions of repair and maintenance; Importance of maintenance. Different maintenance systems- breakdown, preventive, planned; predictive maintenance through condition monitoring; Safety engineering, Maintainability, failure pattern, availability of equipment / systems, design for maintainability. **Total Productive Maintenance (TPM):** definition, objective & methodology; Implementation of TPM; Lean maintenance; Overall equipment effectiveness (OEE)	5 4
2	**Organizational structures for maintenance:** Objective; Maintenance functions and activities; Organizational requirements; Types of maintenance organizations, maintenance planning & scheduling. Manpower planning; Engineering stores. **Economic Aspect of Maintenance:** Life cycle costing; Maintenance cost & its impact; Maintenance budget; Cost control; Maintenance audit- Procedure, tools,	4 5

	planning, reports.	
3	**Function and use of Maintenance Equipment, Instruments & Tools:** Facilities like NDT, painting, coating and cladding, Gas cutting and welding, crack detection, vibration monitor, balancing equipment, compressor, basic machine tools, lubricators and lubricants, chain pulley block, Tools like different types of wrenches, torque wrench, pipe wrench, plier, screw driver, dimension measuring instruments, feeler gauge, scraper, fitting shop tools, spirit level, hand grinder & drill, screw jack, etc. **Lubrication:** Purpose & importance; Type of lubricants, Properties of lubricants; Types of lubrication and their typical applications, lubrication devices, centralized lubrication system; Gasket, packing and seals;	5 4
4	**Repair & Maintenance Procedures:** Repair of cracks, threads, worn shafts, keyways, bush bearing, damaged gear tooth. Assembly and dismantling of antifriction bearing; Maintenance of bearing, clutches, coupling, brakes, Alignment of shafts, belt and chain drives, gear drives, centrifugal pump, pipe and pipe fittings, small induction motors; Steps for installation of a machine.	9
	Total Classes	**36**

Text Books:

1. Maintenance Engineering and Management- Mishra and Pathak, PHI.
2. Maintenance Engineering and Management- Srivastava, S. Chand & Company Ltd., New Delhi.
3. Maintenance Engineering and Management- K. Venkataraman, PHI.

09/08/2022

Course Name : MATERIALS HANDLING					
Course Code: MECH 3263					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Interpret the importance of materials handling (UNDERSTAND)
CO 2	Identify the application of different types of materials handling systems and equipments (REMEBERING)
CO 3	Implement the concept of maximizing productivity for designing of effective materials handling system (APPLY)
CO 4	Infer suitable materials handling equipment for specific applications (ANALYZE)
CO 5	Evaluate alternative or innovative solutions, concepts and procedures for effective utilization of materials handling equipments (EVALUATE)
CO 6	Develop specific conveying equipment for designated bulk material handling systems (CREATE)

Module	**Syllabus**	**Contact Hrs.**
1	**Introduction :** Definition, importance and scope of materials handling (MH); Objectives of Material Handling; classification of materials; codification of bulk materials; utility of following principles of MH – (i) materials flow, (ii) simplification, (iii) gravity, (iv) space utilization, (v) unit size, (vi) safety, (vii) standardization, (viii) dead-weight, (ix) idle time (x) motion. **Unit load :** Definition; advantages & disadvantages of unitization; unitization by use of platform, container, rack, sheet, bag and self contained unit load; descriptive specification and use of pallets, skids, containers, boxes, crates and cartons; shrink and stretch wrapping. **Classification of MH Equipment :** Types of equipment – (i) industrial trucks & vehicles, (ii) conveyors, (iii) hoisting equipment, (iv) robotic handling system and (v) auxiliary equipment; Independent equipment wise sub classification of each of above type of equipment.	9
2	**Industrial trucks & vehicles:** Constructional features and use of the following equipment – (i) wheeled hand truck, (ii) hand pallet truck, (iii) fork lift truck; Major specifications, capacity rating and attachments of fork lift truck. **Auxiliary Equipment :** Descriptive specification and use of – (i) Slide and trough gates, (ii) belt, screw and vibratory feeders, (iii) Chutes, (iv) positioners like elevating platform, ramps, universal vise; (v) ball table.	8

3	**Conveyors :** Use and characteristics of belt conveyor, constructional features of flat and troughed belt conveyor; Use and constructional features of Flg. types of chain conveyors – apron, car and trolley type; Construction of link-plate chains; Dynamic phenomena in chain drive; Use and constructional features of roller conveyors; Gravity and powered roller conveyor; Pneumatic conveyor-use and advantages; Positive, negative and combination system of pneumatic conveyors; constructional feature, application and conveying capacity of screw conveyor, bucket elevator.	9
4	**Hoisting Equipment:** Advantage of using steel wire rope over chain; constructional features of wire ropes; Rope drum design; Pulley system-simple vs. multiple pulley; Load handling attachments : hooks, grabs, tongs, grab bucket; Arrangement of hook suspension with cross piece and pulleys (sheaves); Use and constructional features of (i) hand operated trolley hoist, (ii) winch; (iii) Jib crane, (iv) overhead traveling crane and (v) wharf crane; Level luffing system of a wharf crane; Utility of truck mounted and crawler crane. **Robotic handling:** Materials handling at workplace; Major components of a robot; Applications of robotic handling; AGV (automated guided vehicle)	10
	Total Classes	**36**

Books Recommended:

1. Introduction to Materials Handling- S. Ray, New Age Int. Pub.
2. Mechanical Handling of Materials- T. K. Ray, Asian Books Pvt. Ltd.
3. Materials Handling: Principles and Practices- T.H. Allegri, CBS Publishers and Distributors.
4. Material Handling System Design- J.A. Apple, John Wiley & Sons.

09/08/2022

Course Name : CAD/CAM					
Course Code: MECH 3264					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of this course students will be able to

CO1	Understand the working methodology of different Drawing and Transformation tools of any drafting and design software which will help them to work with the drafting and design software at the program level.
CO2	Use the detailed understanding about the mathematical approach of Analytical as well as Synthetic curve building, Surface generation and 3D modeling when they will be working in the field of research and development.
CO3	Adoptcorrect element type and meshing parameters when they will analyze any physical phenomenon with structural load or thermal load or thermo mechanical load using Finite Element Method
CO4	Select the correct parameters of process planning where Computer Integrated Manufacturing (CIM) plays very important role in the whole manufacturing procedure for efficient production of any product.
CO5	Generate as well as check 'G' code and 'M' code sequence of any part programming for machining with CNC or DNC machines in any manufacturing process.
CO6	Accustom themselves in the modern design, development and manufacturing activities in the now-a-days industries.

Module No.	**Syllabus**	**Contact Hrs.**
Module 1	**INTRODUCTION:** Fundamental of Computer Aided Design process, Benefits of Computer Aided Design process, Basics of Computer Graphics, Transformations-Introduction, Formulation, Translation, Rotation, Scaling, and Reflection. Homogenous Representation, Concatenated Transformation, Mapping of Geometric Models, Inverse Transformations.	8
Module 2	**MODELLING:** Curves: - Introduction, Analytic Curves - Line, Circle, Ellipse, Parabola, Hyperbola. Synthetic Curves - Bezier Curve, B-Spline Curve and NURBS. Numericals on Line, Circle, Ellipse. Surfaces:- Introduction, Surface Representation, Analytic Surfaces, Synthetic Surfaces, Bezier surfaces, B-spline Surfaces, Coons Surface [no analytical treatment]. Solids:- Introduction, Geometry and Topology, Solid Representation, Boundary Representation, Euler's equation, Constructive Solid Geometry, Boolean operation for CSG, Hybrid	10

	Modeling, Feature Based Modeling, Parametric Modeling, Constraint Based Modeling, Mass, area, volume calculation.	
Module 3	**FINITE ELEMENT ANALYSIS:** Introduction, Stress and Equilibrium, Boundary Condition, Strain – Displacement Relations, Stress- Strain Relation, Potential Energy and Equilibrium: - Rayleigh-Ritz Method, Galerkin's Method. One Dimensional Problem: Finite Element Modelling, Coordinate and Shape function, Potential Energy Approach, Galerkin Approach, Assembly of Stiffness Matrix and Load Vector, Finite Element Equations, Quadratic Shape Function, Temperature Effects . Trusses: Introduction, 2D Trusses, Assembly of Stiffness Matrix.	10
Module 4	**COMPUTER AIDED MANUFACTURING:** Introduction to computer aided manufacturing (CAM) systems, Basic building blocks of computer integrated manufacturing (CIM). CNC programming using CAM Software.	8
	Total	**36**

Text Books:

1. CAD/CAM - Theory and Practice, Ibrahim Zeid and R. Sivasubramanian, Tata McGraw Hill Publishing Co.
2. Introduction to Finite Elements in Engineering, Chandrupatla T.R. and Belegunda A.D, Prentice Hall India.

Reference Books:

1. Fundamentals of Finite Element Analysis, David V. Hutton, Mcgraw-Hill.
2. Introduction to CAD/CAM, P N Rao, Tata McGraw Hill Publishing Co.
3. Automation, Production Systems and Computer Integrated Manufacturing, Groover M. P., Prentice Hall of India

09/08/2022

Course Name : OPERATIONS MANAGEMENT					
Course Code: MECH 3265					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completion of the course, students will be able to:

- Appreciate importance of production and operations management.
- Learn various forecasting methods.
- Apply inventory control strategies and plan materials requirement in an industry.
- Implement concepts of machine scheduling and project scheduling.
- Develop an idea of quantity assurance practices.

Module No.	Syllabus	Contact Hrs.
Module 1	**Introduction**: System concept of production; Product life cycle; Types and characteristics of production system; Productivity, Line balancing.	3
	Forecasting: Patterns of a time series-trend, Forecasting techniques: moving average, simple exponential smoothing, linear regression; Forecasting a time series with trend and seasonal component, Qualitative methods, Forecasting errors.	6
Module 2	**Materials Management and Inventory Control :** Components of materials management; Inventory control : EOQ model, Economic lot size model, Inventory model with planned shortages, Variable demand and variable lead time, ABC analysis; Just-in-time inventory management.	6
	Materials Requirement Planning: MRP concept – bill of materials (BOM), master production schedule; MRP calculations. Concept of aggregate planning.	4
Module 3	**Machine Scheduling:** Concept of Single machine scheduling – shortest processing time (SPT), Minimize mean flow time, Earliest due date (EDD), Minimize maximum lateness, Total tardiness Minimizing model; Johnson's rule for 2 and 3 Machines scheduling.	4
	Project Scheduling: Activity analysis; Network construction; critical path method (CPM), PERT; Crashing of Project network, Resource planning.	5
Module 4	**Quality Assurance:** Meaning of Quality; Quality assurance system; choice of process and quality; Inspection and control of quality; Maintenance function & quality; Process control charts : X-chart and R-Chart, p-chart and c-chart; Acceptance sampling : Operating characteristic (O.C) curve, Single sampling plan, Double sampling plan, Acceptance sampling by variables; concept of Six Sigma.	8
	Total	**36**

Text Books:

1. Modern Production/Operations Management, Buffa and Sarin, John Wiley & Sons.
2. Production and Operations Management, R. Panneerselvam, PHI.
3. Operations Management, Russell & Taylor, PHI.

Reference Books:

1. Production and Operations Management, Adam and Ebert, PHI.
2. Production & Operations Management, Starr, Cenage Learning India

09/08/2022

Professional Elective II

Course Name : TOTAL QUALITY MANAGEMENT (TQM)					
Course Code: MECH 3141					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Explain the concepts of Total Quality Management and Total Quality Education (UNDERSTANDing)
CO 2	Identify the problems in Quality Improvement Process (REMEBERING)
CO 3	Apply various Quality Improvement Techniques(APPLYING)
CO 4	Analyze Statistical Process Control(SPC) data to improve processes (ANALYZE)
CO 5	Appreciate the incorporation of ISO System standard and its benefits(EVALUATE)
CO 6	Propose how business leaders might plan and execute quality management straggles to gain and sustain competitive advantage in today's global business arena (CREATE)

Module	Syllabus	Contact Hrs.
1	**Introduction:** Definition of quality ; Quality control vs. Quality Assurance ; TQM- Components of TQM; TQM vs. TPM; Quality Gurus ; Quality Planning and Quality costs; Collection and reporting of quality cost information; Leadership role in TQM; Role of senior management in TQM; Implementation and Barriers to TQM ; Customer Satisfaction-Customer perception of quality-customer complaints- customer feedback- customer retention; Employee involvement.	9

2	**QMS (ISO 9000):** Evolution of QMS- ISO 9000 series of standards- Quality manual – ISO 9001 requirements ; Different clauses of ISO 9001 system and their applicability in various business processes ; Documentation ;Internal Audits and Implementation; ISO 9000 certification process. **EMS (ISO 14000):** Concepts of ISO 14001 ; Requirements of ISO 14001 ; Benefits of ISO 14001	9
3	Continuous process improvement; PLAN-DO-CHECK-ACT (PDCA); 7 QC tools and their use for quality improvement; Quality Function Deployment; QFD team ; Benefits of QFD; QFD Process KAIZEN; 5 – S Principle; Concept of quality circles.	9
4	Statistical process control; Measures of central tendency; Measurers of dispersion; control charts for variables; Control charts for attributes; OC Curve ; Process capability; six sigma and its applications; Design of experiments and Taguchi Methodology	9
	Total Classes	**36**

Text Books:

1. Total Quality Management – J.D. Juran , MHE.
2. Total Quality Management - Besterfield,Pearson Education.

Reference Books:

1. Total Quality Management – Arasu & Paul , Scitech.
2. Total Quality Management – Poornima M Charanteemath , Pearson Education .

09/08/2022

Course Name : DYNAMICS OF MACHINES					
Course Code: MECH 3101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	**Analyze** the dynamic forces and torque in a reciprocating mechanisms.
CO 2	**Understand** the application of a flywheel and **Evaluate** the fluctuation of energy.
CO 3	**Evaluate** an unbalanced system and **solve** the problem for balancing the same graphically and analytically.
CO 4	**Analyze** a free and forced single degree vibrating system with and without damping.
CO 5	**Understand** the gyroscopic effects and **analyze** stability of motion of different system based on the effects.
CO 6	**Understand** and **explain** different governors used in different applications.

Module	**Syllabus**	**Contact Hrs.**
1A	**Dynamic analysis of Mechanism:** Inertia force and inertia torque in reciprocating engine; Dynamic Equivalent System; correction couple (torque); Turning moment diagram and flywheel design.	5
1B	**Introduction:** Definition & types of vibration **Free Undamped Vibration:** Determination of Equation of motion and solution function of a linear and rotary vibratory motion by Equilibrium method, Energy method (Rayleigh's maximum energy principle), About Natural Frequency of the free undamped linear and rotary vibration. Effect of inertia in longitudinal vibration and its natural frequency.	4
2A	**Linear Free Damped Vibration:** Equation of motion and solution function for free damped vibration. Understanding the damping factor or ratio. A detailed discussion about under damped motion, critically damped motion and over damped motion. Logarithmic decrement.	3
2B	**Forced Damped Vibration:** Equation of motion and solution function for forced damped vibration. Understanding the physical significance of the solution. Steady state condition and amplitude. Dynamic Magnification Factor and phenomenon of resonance. Vibration Isolation and Transmissibility. Effect of unbalance and support motion.	4

09/08/2022

2C	**Transverse vibration of Shaft:** Vibration with single concentrated load, uniformly distributed load and with several loads (Dunkerley's Method and Energy Method), Whirling of shaft and calculation of critical speed.	3
3	**Balancing**: Static balancing and dynamic balancing of rotating masses - graphical and analytical methods; Balancing of reciprocating mass – primary and secondary balancing; Balancing of Locomotive; Effects of partial balancing in Locomotives (Swaying couple; Hammer blow); Balancing of inline Engine; Balancing of V- Engine.	9
4A	**Governors**: Use and classification; Study and analysis of Porter, Proell, Hartnell and Wilson-Hartnell governors; Sensitiveness, stability, isochronism, hunting, effort and power of governors; Controlling force diagram and stability criteria analysis; coefficient of insensitiveness.	4
4B	**Gyroscope:** Gyroscopic Torque; Gyroscopic effects on Aero-plane; Gyroscopic Effects on Naval Ship; Stability of an Automobile; Stability of Two-wheel Vehicles.	4
	Total Classes	**36**

Text Books:

3. Theory of Machines – S S Rattan, Tata McGraw Hill, 4e, 2014.
4. Theory of Machines – R. S. Khurmi and J. K. Gupta, S. Chand Technical, 14e, 2005.

Reference Books:

1. Theory of Machines and Mechanisms – Uicker, Pennock and Shigley, Oxford University Press, 3e, 2009.
2. Kinematics and Dynamics of Machinery – R. L. Norton, McGraw Hill Education, 1e, 2009.
3. The Theory of Machines through Solved Problems – J. S. Rao, New Age International Publication, 1e, 2012.
4. Mechanism and Machine Theory – Ashok G. Ambekar, PHI Learning, 1e, 2007.
5. Theory of Mechanisms & Machines (3rd edition) – Ghosh and Mallik; East West Press, 3e, 2006.

09/08/2022

Course Name : DESIGN OF MECHANICAL SYSTEMS-I					
Course Code: MECH 3103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

<u>Course Outcomes:</u>

On completion of this course students will be able to

CO1	Select suitable material of the object to be designed, as per the requirement of strength and other physical properties in accordance with the given loading and boundary conditions.
CO2	Judge relevant 'Mode of Failure' and 'Theory of Failure' when designing an object according to a required failure criteria under specified loading condition and boundary constraints.
CO3	Design machine components under different types of loading like tensile, bending and torsional with different combinations of two dimensional stress conditions.
CO4	Justify the design of an object subjected to reversed or fluctuating load with different combinations of loading types like tensile, bending and torsional for infinite life as well as for any specified finite life.
CO5	Determine the size specifications of power screw and fastening components like nut-n-bolt, rivets with its required arrangements and various welds according to object dimensions, type of use and loading imposed.
CO6	Design the specification of transmission shaft, keys, flanges and belt for the purpose of a power and torque transmission in a machine.

Module	Syllabus	Contact Hrs.
1A	**Introduction:** Objective and scope of Mechanical Engineering Design, Design considerations; Review and selection of materials and manufacturing processes; codes and standards, Importance of preferred size.	4
1B	**Design Under Static Load:** Modes of failure; Design/allowable stress; Factor of safety (fs); Bi-linear Stress –Strain; Theories of failure– maximum normal stress theory, maximum shear stress theory, Distortion energy theory. Choice of Failure criteria; Design for stability: buckling analysis – Johnson and Euler columns, Design of (i) Cotter joint; (ii) Knuckle joint.	8
2	**Design Under Fluctuating Load:** Fatigue in metals; S-N curve; Endurance limit and fatigue strength; Stress concentration factors – effect of discontinuity, fillets and notches; Effect of size, surface finish, stress concentration and degree of reliability on endurance limit; Design for finite and infinite life; Cumulative fatigue damage – Miner's equation, Goodman, modified Goodman and Soderberg diagrams with respect to fatigue failure under variable stresses; Fatigue design under combined stresses.	11

3	**Design of :** **(a) Bolted joints** : Fasteners- Metric thread, standard sizes, use of lock nuts and washers; Applications in structures including brackets, turn buckle; Pre-stressed bolts, Design under concentric loading and eccentric loading (b) **Riveted joints** : Unwin’s formula; Brief discussion on single, double and triple row lap joints, butt joints with single or double strap / cover plate; simple strength design; joint efficiencies, Design under concentric loading as well as eccentric loading. (c) **Welded Joints**: Butt Joint, Single Fillet and Double Fillet Joint under concentric loading as well as Eccentric Loading **Design of Transmission screw and Screw jack.**	10 2
4	**Design of :** (i) Solid and hollow shafts: design under transverse and torsional load. (ii) Helical compression spring: stress and deflection equations, stiffness, curvature effect : Wahl’s factor, springs in parallel and series. (iii) Multi-leaf springs: load-stress and load-deflection equations, Nipping. (iv) Shaft coupling-rigid, pin-bush and geared flexible type, alignment of coupling. (v) Belt drives-geometrical relations, derivation of torque and power transmission by flat and V-belt drives, selection of belt from manufacturers’ catalogues, pulley. (vi) Chain drives – roller chains, polygonal effect, power rating, sprocket wheel, silent chain.	13
	Total Classes	**48**

Text Books:

1. Design of Machine Elements - V. B. Bhandari, TMH.
2. Fundamentals of Machine Design - P.C. Gope, PHI.

Reference Books:

1. Mechanical Engineering Design – Shigley and Mischke, TMH.
2. Theory and Problems of Machine Design – Hall, Holowenko and Laughlin, TMH.
3. Design of Machine Elements – M.F. Spotts, Prentice Hall.
4. Machine Design – P. Kannaiah, Scitech Publications.

09/08/2022

Course Name : DYNAMICS OF MACHINES LAB					
Course Code: MECH 3211					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	To teach students concepts of generalized forces, couple and the principle of virtual work.
CO 2	To create linkage, cam and gear mechanisms for a given motion or a given input/output motion or force relationship.
CO 3	To remember and understand the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.
CO 4	To analyze and evaluate the forces and motion of complex systems of linkages, gears and cams.
CO 5	To understand and remember the concepts of static and dynamic mass balancing and flywheels
CO 6	To Analyze mathematical models used dynamical analysis of machinery.

List of Experiments:

1. Studying and designing different mechanisms for performing specific tasks in a machine tool and for common engineering applications.
   I. Four bar mechanism
   II. Slider crank mechanism
   III. Whitworth quick return mechanism
   IV. Crank slotted lever mechanism
2. Experiments on working of governor, operation and analysis.
   I. Watt governor
   II. Porter governor
   III. Proell governor
   IV. Hartnell governor
3. Experiments on working of gyroscope, operation and analysis.
4. Drawing a cam.
5. Studying operation of cams and its analysis.

Samas
09/08/2022

6. Static and dynamic balancing of rotating masses.
7. Balancing of reciprocating masses.
8. Studying vibratory systems of single and more than one degree of freedom in linear and rotary systems.

N.B. A minimum of six jobs / experiments must be performed in the semester.

09/08/2022

Course Name : DESIGN OF MECHANICAL SYSTEMS –II					
Course Code: MECH 3251					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of this course student will be able to:

CO1	Know different technical terminologies of different gears and their physical interpretation.
CO2	Understand design methodology of different gears like Spur, Helical, Bevel and Worm wheel.
CO3	Implement all the technical nitty-gritty in the process of pressure vessel design with thermo-mechanical loading.
CO4	Impart fruitful contribution in the process of sliding contact and rolling contact bearing design and selection.
CO5	Take active participation in the process of designing and/or selectionof Clutch and Brake for a drive system.
CO6	Become an active member in the design validation and modification activity as well as R-n-D activity in any Industry and/or Research.

Module	Syllabus	Contact Hrs.
1A	**Gear Design- Introduction:** Design objectives of Gears, Classification of Gears and their Technical Terminologies, Different tooth profile of Gears, Interference and Undercutting, Backlash of Gear, Gear materials, Laws of gearing.	2
1B	**Design of Spur Gear:** Strength design, static and dynamic considerations in strength design, Lewis formula, Lewis form factor, beam strength, Buckingham equation for dynamic tooth load; Endurance strength and wear strength; Designing a pinion based on above considerations.	4
1C	**Design of Helical Gear:** Helical Gear: Helix angle, minimum face width, virtual number of teeth; Strength design, Buckingham formulae for checking dynamic load and wear load.	2
2A	**Design of Bevel Gear:** Terminologies, formative number of teeth; Lewis equation, dynamic load, endurance strength and wear strength checking.	2
2B	**Design of Worm- worm wheel:** Terminologies and their inter-relation; Preferred combination of various parameters; Efficiency; Materials.	2

2C	**Design of Pressure vessels**– thin cylinder, thick cylinder, Lame's equation, Clavarino's equation, Bernie's equation, Autofrettage– compound cylinders, End Covers, Opening in pressure vessel – area compensation method, Fired and unfired vessels – category, Industrial Code.	5
3	**Design of Clutch and Brakes:** **Clutches:** Function, types; Friction clutches – torque capacity based on uniform pressure and uniform wear theory for disc and cone clutch; Centrifugal clutch; Friction materials; Considerations for heat dissipation. **Brakes:** Function, types; pivoted block brake (single and double block brakes), internal expanding shoe brake, self-energizing and self-locking; Pivoted block brake; Band brake-simple and differential; Energy equation for braking time calculation; Magnetic and hydraulic thruster operated fail-safe brakes; Brake lining materials; Thermal considerations during braking.	9
4A	**Design of Sliding contact bearings:** Bearing types and materials; Stribeck Curve, Petroff equation, Hydrodynamic lubrication theory - pressure development; Tower experiment, Reynolds equation, Finite bearings – Raimondi-Boyd charts, Design factors/variables, Heat generation & dissipation; Hydrostatic bearing; Plummer block.	6
4B	**Rolling contact bearings:** Bearing types, nature of load; Static and dynamic load capacity, Stribeck equation ,Load - Life relation; Bearing selection from manufacturers' catalogues; Methods of lubrication; Bearing mounting on journal and bearing block.	4
	Total Classes	**36**

Text Books:

1. Design of Machine Elements- V. B. Bhandari, TMH.
2. Fundamentals of Machine Design- P.C. Gope, PHI.

Reference Books:

1. Mechanical Engineering Design- Shigley and Mischke, TMH.
2. Theory and Problems of Machine Design- Hall, Holowenko and Laughlin, TMH.
3. Design of Machine Elements- M.F. Spotts, Prentice Hall.
4. Machine Design- P. Kannaiah, Scitech Publications.

09/08/2022

Course Name : Genetics					
Course Code: BIOT3101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes:
After completing the course, the students will be able to:

1. Understand the basic principles of Mendelian mode of inheritance and also analyze the reasons behind the exceptions to this phenomenon.
2. Interpret the different modes of linkage, sex determination patterns and chromosomal abnormalities.
3. Identify and analyze the genetic network of carcinogenesis to reach out for novel therapeutic strategies.
4. Comprehend the mechanism of action of microbial genetics and genetic patterns of embryonic development.
5. Apply the mathematical and biostatistical models in biological systems for testing of hypotheses, estimation of group differences and case-control studies.
6. Use the Hardy-Weinberg model to quantify the allele frequency in a population for better understanding of evolutionary changes and gene flow.

Module I: Classical Genetics and its deviations [10L]
Principles of Mendelian inheritance, multiple alleles, pseudoallele, Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and chromosome mapping, sex linkage, sex limited and sex influenced characters; sex determination, extra-nuclear inheritance, special types of chromosomes; structural and numerical chromosomal abnormalities and their genetic implications; pedigree analysis, lod score for linkage testing, linkage disequilibrium.

Mod-II: Mutation and Cancer Genetics [10L]
Gene Mutation: Induced and spontaneous mutation, mutation types, causes and detection, mutant types. Molecular basis of genetic disorders, karyotypes, inborn errors of metabolism. Cancer Genetics: genetic rearrangements in progenitor cells, oncogenes, proto-oncogenes, tumour suppressor genes – p53, RB and others, virus-induced cancer; cell cycle check points and cancer.

Module III: Microbial and Developmental Genetics [10L]
Methods of genetic transfers: transformation, conjugation, transduction and sex-duction. Gene mapping methods: interrupted mating, recombination and complementation analysis. Genetics of animal virus. Developmental genetics in Drosophila model: egg-polarity genes and formation of body axes; molecular control of segmentation: gap genes, pair-rule genes, segment polarity genes; homeotic genes, Wnt and cadherin pathways; cellular ageing & senescence.

Srabanti Basu

Module IV: Biostatistics and Population Genetics [10L]

Biostatistics: Mean, median, mode, standard deviation, variance, discrete and continuous probability distributions, Poisson, normal and binomial distributions; T test, chi-square analysis, ANOVA. Population genetics: Hardy-Weinberg equilibrium, allele frequency and genotype frequency. Extensions of H-W equilibrium: mutation, selection, continuous variation, genetic drift, migration.

Textbook:

1. Concepts of Genetics, 7th edition. M.R. Cummings, A.W. Klug. Pub: Pearson Education.
2. Genetics, 3rd edition. M.W. Strickberger. Pub: Pearson Education.

Reference Books:

1. Introduction to Genetic Analysis, 8th edition, Anthony J. F. Griffiths, Jeffrey H. Miller, David T. Suzuki, Richard C. Lewontin, and William M. Gelbart. Pub: W.H. Freeman & Co.
2. Principles of Genetics, 5th edition. D. Peter Snustad, Arthur J. Simmons. Pub: John Wiley & Sons.
3. iGenetics: a Conceptual Approach, 3rd edition. Peter J. Russell. Pub: WH Freeman & Co.
4. Microbial Genetics, 2nd edition. Stanley R. Maloy, John E. Cronan, David Freifelder. Pub: Jones and Bartlett Publisher Inc.
5. Genetics: analysis of genes and genomes, 6th edition. D.L. Hartl & E.W. Jones. Pub: Jones and Bartlett Publishers.
6. An introduction to Human Molecular Genetics: Mechanism of Inherited Diseases. 2nd edition. J. Pasternak. Pub: Fitzgerald Science Press.
7. Developmental Biology, 10th edition. S.F. Gilbert. Pub: Sinauer Associates.
8. Introduction to Biostatistics, 2nd edition, Pranab Kumar Banerjee. Pub: S. Chand & Co.
9. Problems on Genetics, Molecular Genetics and Evolutionary Genetics. Pranab Kumar Banerjee. New Central Book Agency Pvt. Ltd.
10. Statistics in Biology and Psychology, 4th edition. Debajyoti Das, Arati Das. Academic Publishers.

Course Name : Bioinformatics					
Course Code: BIOT3102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module 1: Bioinformatics Resources and Databases [10L]

Definition and application of bioinformatics to biological research; Introduction to different primary and secondary databases (viz: Genbank,PDB) introduction to different modules of NCBI

Module 2: Sequence Analysis of proteins and nucleic acids [10L]

Introduction to sequence analysis, Basic concepts: Sequence similarity, identity and similarity, definitions of homologues, orthologues, paralogues, Tandem and Interspersed repeats, local and global alignment, pair wise and multiple alignment, sequence alignment algorithm: Needleman - Wunsch and Smith-Waterman algorithms; Substitution Matrices; Introduction to phylogenetics analysis through multiple sequence alignment: CLUSTALW A brief introduction to gene prediction

Module 3: Perl Programming [10L]

Accessing and installing Perl and BioPerl , Using modules, like BioPerl. Sequences and Strings: Variables, Arrays, Files .Motifs and Loops-Flow control, String operators, Writing files. Subroutines –Scoping, Arguments, Command line arguments, passing data to subroutines, Modules and Libraries, Debugging. Data Structures and Algorithms for Biology-Hashes, Translating DNA into Proteins, Working with the FASTA Format, Reading frames. Regular Expressions.

Module 4: Protein structure prediction and drug designing [10L]

Hierarchical organization of protein structures-e.g.SCOP, CATH; Secondary structure prediction via Chou-Fasman , GOR and other methods; Hidden Markov Model and Neural network algorithms and their applications; 3D protein structure prediction using homology modeling, fold recognition and ab-initio methods; CASP; Drug design applications: Receptor-ligand interactions; binding sites, docking and virtual screening; Structure and Ligand Based drug design; QSAR and in silico predictions of drug activity and ADMET.

Textbook:

1. Xiong.J, Essential Bioinformatics, Cambridge University Press
2. An Introduction to Bioinformatics, Arthur W. Lesk, Cambridge University Press.
3. Bioinformatics-Principles and applications-Ghosh and Mallick- Oxford University Press.
4. James Tisdall, Beginning Perl for Bioinformatics, SPD

Reference books:

1. Cynthia Gibbs and Per Jambeck, Introduction to Bioinformatics computer Skills, 2001 SPD
2. Atwood, Introduction to Bioinformatics, Person Education
3. Baxevanis, A.D, Quellette. B.F.F, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins.
4. Andrew Leach, Molecular Modelling: Principles and Applications,Pearson Education
5. Molecular Modelling and Drug Design-K.Anand Solomon-1st edition (2011)-MJP Publishers

Course Name : Recombinant DNA Technology					
Course Code: BIOT3103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module -I: Tools of Recombinant DNA Technology [10L]

DNA & RNA manipulating enzymes and other tools used in Recombinant DNA technology: Restriction endonuclease; DNA polymerases (DNA Pol I, T4, T7, Taq), reversetranscriptases, DNA ligases; alkaline phosphatases; polynucleotidekinase; terminal deoxy-nucleotidetransferase; topoisomerases; DNase; RNase and others; linker and adapter. Physical map, specific host and features of Vectors: Plasmids, bacteriophage vectors, cosmids, phagemids, PAC, BAC, YAC, and MAC, Expression vectors (pET vectors, Baculovirus vectors and others).

Module -II: Techniques Recombinant DNA Technology: [10L]

DNA and RNA labeling (radioactive and non radioactive methods); Restriction mapping; DNA sequencing (Maxum & Gilbert, Sangers, pyro-sequencing, and others methods); Protein and RNA sequencing; Polymerase chain reactions (PCR), different modified PCR and Real time PCR; Techniques of separation of nucleic acid and protein (electrophoresis, chromatography and others); Southern, northern, and western blotting & hybridization; In-situ hybridization; Site-directed mutagenesis; DNA and protein based microarray.

Module -III: Gene Cloning Methods: [10L]

Isolation and preparation of DNA fragments from prokaryotic and eukaryotic source; Different types of cloning and expression methods of gene in prokaryotic and eukaryotic host cell system using different vectors (by restriction enzyme, PCR product cloning and other methods); Transfer of recombinant DNA into host; Screening & Expression of cloned gene; Gene isolation; Subcloning strategies; Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors and their screening.

Module - IV: Application of Recombinant DNA technology [10L]

Genetically engineered vaccine; DNA vaccine; recombinant Biopharmaceuticals (insulin, human growth factor and others); Gene therapy (gene transfer technologies, antisense and ribozyme technology); Molecular biomarker in disease diagnostics and forensic science (RFLP, RAPD, AFLP SNP, EST and others), DNA fingerprinting; Human genome project (strategies for genome sequencing and its application); Genetically modified organism and food; Large scale gene expression analysis.

Srabanti Basu

Textbook:

1. Principles of Gene Manipulation& Genomics, 7th Ed, (2006) Old and Primrose, Pub: Blackwell Scientific.
2. Genetic Engineering by S. Rastogi and N. Pathak, Pub: Oxford Univ. Press.
3. Molecular Cloning: A Laboratory Manual (3-volume set 4th Edn.): (2012) by Michael R. Green, Joseph Sambrook , Pub: CSHL press

Reference books:

1. Molecular Biotecnology: Principles and Applications of Recombinant DNA, 4th Edn. (2010) by Glick, Pasternak and Pattern. Pub: ASM press
2. Recombinant DNA: Genes and Genomes - A Short Course, 3rd Edn. (2007) by James D. Watson, Richard M. Meyers , Amy A. Caudy, Jan A. Witkowski. pub: CSHL
3. H.K. Das, Text Book of Biotechnology, 4th ed, 2010, Wiley Publishers
4. Genetics a Molecular Approach, 7th Ed (2010) by Brown, T.A., pub: Chapman and Hall,
5. Genomes, 3rd ed (2006) by Brown TA, Pub: Garland Science
6. Human Molecular Genetics, 4th Ed. (2011) by Tom Strachan, Andrew Read**,** Pub: Garland Science

Course Name : Transfer Operations - II					
Course Code: BIOT3104					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

After completing the course, the students will be able to:

1. Understand the concept of diffusion and diffusivity and identify the type of diffusion in a given problem and solve it.
2. Determine gas-liquid mass transfer coefficient in a wetted wall column or packed bed absorption column and calculate the number of stages required for the unit operation.
3. Apply McCabe-Thiele Method and Rayleigh's equation as required in a distillation process.
4. Comprehend different other unit operations like adsorption, liquid-liquid extraction and crystallization explicitly.
5. Draw the drying characteristic curve under a given constant drying condition.
6. Study and apply the principle and operation of different advanced separation processes like dialysis, ultrafiltration, reverse osmosis, pervaporation and electrodialysis in the field of biotechnology.

Module I: Introduction to Mass Transfer [10L]

Introduction to Mass Transfer: Molecular diffusion in fluids. Diffusivity, Mass Transfer Coefficients, Interphase

Mass Transfer, Gas Absorption, co-current and counter-current multistage operation, Packed Tower, Drying, adsorption and Leaching principles

Module II: Distillation [10L]

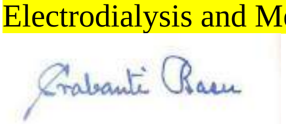
Distillation: Vapor-liquid equilibrium, Rayleigh's Equation, Flash and Differential distillation, McCabe-Thiele Method to determine stages

Module III: Miscellaneous Mass Transfer Operations [10L]

Liquid–liquid equilibrium. Liquid extraction, Stagewise contact; Adsorption Equilibria: batch and fixed bed adsorption, Batch drying and mechanism of batch drying. Freeze drying, Basic idea of crystallization

Module IV: Advanced Separation Processes [10L]

Advanced Separation Processes: Dialysis, Ultrafiltration, Reverse osmosis, Pervaporation, Electrodialysis and Membrane separation- Principle and operation



Textbook:

1. Unit Operations of Chemical Engineering: McCabe,Smith & Harriot, TMH, 5thedition

Reference books:

1. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition

Course Name : Immunology					
Course Code: BIOT3201					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes:

After completing the course, the students will be able to:

1. Understand the basic principles of innate and adaptive immunity and the underlying mechanisms of cellular and humoral immune responses.
2. Develop an idea about strcuture, biogeensis, function and molecular diversity of different antibody classes.
3. Apply the techniques of antibody engineering and antigen-antibody reactions in disease diagnostics and research.
4. Analyze the role of MHC molecules in transplantation and the diseases due to their incompatibility.
5. Understand the immunological basis of hypersensitivity, autoimmunity and immunodeficiency disorders.
6. Gain knowledge about different approaches of vaccine development and their applications in human diseases.

Module 1: Basics of Immunology [10L]

History and evolution of immune system; innate and acquired immunity, hematopoiesis;
humoral and cell-mediated immunity; cells of the immune system; complement system: activation pathways, functions and regulation; primary and secondary lymphoid organs: structure and function; concept of epitope, immunogens, haptens, adjuvants;
B and T cells: maturation, activation and differentiation; organization and rearrangement of TCR genes; macrophage and other Antigen Presenting Cells (APCs).

Module II: Antibodies: structure, functions and applications [10L]

Structure and function of antibody classes, concept of isotype, allotype and idiotype;
genetic basis of antibody diversity: DNA rearrangements, somatic hypermutation, class switching, allelic exclusion; antibody engineering; phage display libraries; antibodies as *in vitro* and *in vivo* probes, abzymes; primary and secondary immune response; monoclonal antibody: hybridoma technology and applications, recombinant and chimeric antibodies, humanized and bispecific antibodies, immunotoxins; antigen-antibody reaction and its application; immunoelectrophoresis, Immunodiffusion, RIA and ELISA.

Module III: Major Histocompatibility Complex (MHC) and host-graft reactions [10L]
General organization, structure and functions of MHC molecules; antigen processing and presentation; transplantation immunology: graft versus host reaction, HLA typing, immunosuppressive therapy; development of inbred mouse strain, blood group classification and Rh factor; cytokines and other co-stimulatory molecules.

Module IV: Immune tolerance, immune disorders and vaccinology [10L]
Immune tolerance: T cell anergy and T cell elimination; hypersensitivity reactions; autoimmunity with respect to Myasthenia gravis and Rheumatoid arthritis; immunodeficiency, animal models for disease study; tumour immunology: tumour antigens, tumor vaccines and immunotherapy; active and passive immunization: live, killed, attenuated, sub-unit vaccines; vaccine technology: recombinant DNA and protein based vaccines, plant-based vaccines; reverse vaccinology; peptide vaccines, conjugate vaccines.

Text books:
1. Immunology and Immune Technology by A. Chaktraborty, Oxford Univ. Pub.
2. Weir, Immunology, 8th ed, W.B. Saunders & Co.

Reference books:
1. Kuby Immunology, 6th edition. T. Kindt, R. Goldsby, B. Osborne. Pub: W.H. Freeman & Co.
2. Immunology, 7th edition. D. Male, J. Brostaff, D. Roth & I. Roitt, I. Pub: Mosby.
3. Cellular and molecular Immunology, 6th edition. .A.K. Abbas, A.H. Lichtman, S. Pillai. Pub: Saunders.
4. Fundamental Immunology, 7th edition. William E. Paul. Pub: Lippincott Williams & Wilkins.
5. Technological Applications of Immunochemicals (BIOTOL). L.S. English. Pub: Butterworth- Heinemann, Oxford Freeman & Co.
6. Immunology. C.V.Rao. Pub: Narosa Publishing House, New Delhi.
7. Janeway's Immunobiology, 7th edition. K. M. Murphy, P. Travers, M. Walport. Pub: Garland Science.
8. Immunology: An Introduction. Tizard. Pub: Cengage Learning India (P) Limited.

Srabanti Basu

<table>
<tr><td colspan="6">Course Name : Plant Biotechnology</td></tr>
<tr><td colspan="6">Course Code: BIOT 3211</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
</table>

Course Outcomes:

On completion of the course, students will be able to:

1. Explain the basic concepts of plant tissue culture and its application of numerous techniques.
2. Interpret how various plant biochemical metabolic pathways work in the plant system and relate them with medicinally important bioactive compounds.
3. Understand basic molecular biological aspects of plant by studying the structure and organization of plant genome
4. Describe the molecular biological techniques of gene transfer to plants.
5. Understand concept of raising transgenic plants
6. Impart knowledge on all recent biotechnological developments related to GMO through quality improvement of crops.

Module I: Plant tissue culture – theory and methods [10L]

Propagation of plant tissue and cells under *in vitro* condition, Totipotency. Role of physico-chemical conditions and hormone requirement for propagation of plant cells and tissues . Mode of action of auxin and cytokinin. Micropropagation via axillary and adventitious shoot proliferation, somaclonal variation and haploid culture, protoplast culture, cybrids. Plant breeding and heterosis. Green revolution in India.

Module II: Mass cultivation of plant cell products: [10L]

Basic strategies and factors for secondary metabolite production, Immobilisation technology for yield enhancement , bioreactor system and models for mass cultivation of plant cells. Biotransformation for product development and selection of cell culture (only plant tissue culture products).

Module III: Structure and organization of plant genome [10L]

Structure, function and assembly of genetic material, regulation of plant genome expression at each step: Chromosome assembly, transcriptional, translational and post transcriptional regulation, protein localization and turnover; Basic structure of chloroplast and mitochondrial genome; rubisco synthesis and assembly. Transposon. (Arabidopsis should be taken as the model for study of plant genome).

Srabanti Basu

Module IV: Plant genetic engineering[10L]

Direct and indirect methods of transgene incorporation; Design of plant expression vectors: Promoters, Plant selectable markers; Reporter genes; Ti-based binary vector system. Agrobacterium mediated gene delivery, Biolistic method. Transgene silencing and strategies to avoid transgene silencing, Chloroplast transformation, Targeted gene delivery and methods of detection.

Theory and techniques for the development of transgenic plants conferring resistance to herbicide (Glyphosate, Basta), pesticide (Bt gene), plant pathogens PR-Proteins. Plant engineering towards development of enriched food products – Golden rice, therapeutic products.

Textbooks:

1. Plant Biotechnology: The Genetic Manipulation of Plants,Slater.A., Nigel W.S,Flower. R.Mark , 2009, Oxford Univesity Press.
2. Comprehensive Biotechnology Ramawat.K.G. ,Goyal, S. 2009, S.Chand & Company, New Delhi

Reference books:

1. Biochemistry and Molecular Biology of Plants Buchaman, Gursam, Jones, , 1ed, 2000, L.K.International.
2. Plant Tissue Culture: Theory and Practice Bhozwani and Razdan –1996 Elsevier
3. In vitro Cultivation of Plant Cells, Butterworth & Heineman, Biotol Series.
4. Tissue culture and Plant science, H.E Street(ed) Academic press, London, 1974
5. Tissue and Organ Culture, Gamborg O.L.,.Phillips G.C, Plant Cell, Narosa Publishing House
6. Text Book of Biotechnology Das.H.K. -First Edition 2004, Wiley Dreamtech.

Srabanti Basu

Course Name : Bioreactor Design and Analysis					
Course Code: BIOT3103					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes:
After completing the course, the students will be able to:

1. Develop basic concept of reaction engineering.

2. Understand basic concepts of bioreactor design and analysis.

3. Understand the basic operating principles of bioreactors.

4. Interpret batch reactor data with reference to basic reactor design for a single reaction ideal reactor.

5. Analyze non-ideal flow pattern with reference to residence time distribution (RTD) and dispersion numbers (D/UL)

6. Analyze basic cell growth data to verify Monod model.

Module I: Basic reaction and microbial growth kinetics [10L]
Sterilization of air and media, Microbial growth and product kinetics: Monod equation, Chemostat, Dimension-less numbers and their importance in reactor operation.
Transport Phenomenon in Bioreactor: Role of dissolved oxygen concentration in mass transfer,Determination of mass transfer coefficient (K_La); Factors effecting K_La and their relationship.

Module II: Ideal Bioreactor [10L]
Overview of Chemical Reaction Engineering, Kinetics of homogenous reactions, Elementary Reactions. Molecularity and Order of reaction.
Introduction to batch reactor data –Different methods of analysis of data, Autocatalytic reactions, Reversible reaction, Differential method of analysis of data,Parallel and multiple reaction.Ideal batch, mixed flow and plug flow reactors and their analysis.

Module III: Non-ideal Bioreactors [10L]
Basics of non-ideal flow: Residence time distribution (RTD), Age distribution of fluids: C, E and F curve, experimental method and their relations,
Dispersion model:its significance and analysis.

Srabanti Basu

Course Name : Molecular Modeling & Drug Designing					
Course Code: BIOT3241					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module I: Molecular Modeling: (10L)

Useful concept in molecular modeling; molecular simulation techniques-Monte Carlo methods-Metropolis Monte Carlo algorithm, types of Monte Carlo algorithm, flow calculations in Metropolis Monte Carlo algorithm with examples; molecular dynamics and simulations- basic concepts including the integration of dynamical Equations; structural information from molecular dynamics, Monte Carlo calculation and energy minimization methods.

Module II: Molecular Mechanics: (10L)

Introduction to Molecular mechanics, intra molecular interactions; physicochemical parameters in drug design: hydrophobicity, electronic effect, ionization constants, chelation, solubility and partition co- efficient; over view of molecular descriptors.

Module III: Drug Discovery, Design and Development: (10L)

Introduction to diseases, drugs and drug targets; pharmacodynamics and pharmacokinetics of drug, rational basis of drug designing, criteria for synthesizing drugs; types of drug designing: ligand based drug design, structure based drug design, lead optimization, receptor based design and other methods;case studies.

Module IV: Tools for Drug Design: (10L)

Overview of computer based tools for drug designing- Ludi, Ludi/CAP, Autodock, GRAMM, CAMD tools; Force fileld and types of force fields; protein-protein, protein-nucleic acid, protein-ligand interaction with example; types of scoring functions, scoring and docking mode; QSAR principles and methods in drug designing; current research in drug designing- a case study.

Textbooks:

1. Molecular Modeling Principles and application, 2nd edn. (2001) by A. Leach. Pub: Pearson
2. Introduction to Medicinal Chemistry (2013) by G. L. Patrick, Pub: OUP

Reference books:

1. Biopharmaceuticals-Biochemistry and Biotechnology 2nd edn. (2003) G.Walsh, pub: Wiley
2. Drug Discovery and Design (2001) by Scolnick. J.; pub: Academic Press,
3. Guidebook on Molecular Modeling in Drug Design (1996) by N. R. Cohen, Editor. Pub:AP,
4. Text Book of Drug Design and Discovery 3rd edn. (2002) by Liljefors, Krogsgaard,-Larsen pub: CRC press.

Course Name : Biophysics of Macromolecules					
Course Code: BIOT3242					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

After completing this course, students will be able to

1. Describe the structure of different macromolecules.
2. Elucidate structure-function relations of enzymes
3. Explain the interactions of macromolecules.
4. Illustrate the thermodynamics and kinetics of macromolecular transition.
5. Describe the spectroscopic techniques for biomolecular structural analysis.
6. Explain the working principle of some non-spectroscopic techniques for structural analysis.

Module1: Fundamental interactions in macromolecules [10L]

Introduction to biophysics, strong and weak interactions in biomolecules: electrostatic and Van der Waal's interaction, hydrogen bonding, hydrophobic Interactions. Conformation and configuration of biomolecules. Structural characteristics of α-helix, β-sheet and β-turn, supersecondary structure, Protein domains and domain architecture. Tertiary structure: effect of amino acids on the structure of proteins. Quaternary structure of proteins. Conformation of nucleic acids: Structural characteristics of A, B and Z-DNA. 3D structure of t-RNA, ribozymes and riboswitches.

Module 2: Thermodynamics and kinetics of macromolecular transitions [10L]

Energy status of a protein molecule, denaturation and renaturation of proteins and DNA, helix coil transformation of proteins and DNA: kinetic study, Melting of helices: thermodynamics of melting / denaturation of alpha helix and DNA double helix, Cooperativity of melting of helices. Structure-function relations of enzymes, allosteric enzymes. Changes in nucleic acid structures during biochemical processes.

Module 3: Spectroscopic techniques for biomolecular structural analysis [10L]

Basic concepts of absorption spectroscopy, UV/visible, IR and FTIR spectroscopy, circular dichroism spectroscopy, NMRS; Emission spectroscopy - luminescence, phosphorescence and fluorescence, quenching, FRET and fluorescence lifetime measurements.

Module 4: Non-spectroscopic techniques for structural analysis

Methods for study of biomolecule structure and surface morphology: X-ray diffraction and X-ray crystallography, and electron microscopy (SEM and TEM), MS, Surface Plasma Resonance Method.

Course Name : Biosensors and Diagnostics					
Course Code: BIOT3243					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I: Introduction to biosensor [10]

Biosensor: Principle, General Characteristics, Advantages and its limitations. Classification of biosensors based on bioreceptor. Immobilization and coupling of bioreceptors. Enzyme Biosensor: Principle, kinetics and its response to different types of inhibitors.

Module II: Bio-recognition element based sensors [10]

Principle, Operation and Limitation of: Microbial sensor, Immunological sensor, Nucleic acid sensor. Other bioreceptors (e.g. animal, plant tissue)

Module III: Biosensor based on transducer [10]

Classification of biosensor based on transducer. Principle, Construction, Calibration and Limitations of Calorimetric, Electrochemical (potentiometric, amperometric), Optical, Piezoelectric, Semiconductor biosensor etc.

Module IV: Application of biosensor [10]

Clinical and diagnostics sector, Industrial sector: Food, Environmental, defense sector and others. Commercially available biosensor.

Reference books:

1. Biosensors by Tran Minh Canh. London. Chapman and Hall, 1993.
2. Turner, A.P.F, Karube.I.,and Wilson,G.S, Biosensors Fundamentals and applications, Oxford Univ. Press.
3. Engineering biosensors, kinetics and design applications by Ajit Sadana..San Diego, Academic Press, 2002.
4. D.Thomas and J.M. Laval – Enzyme Technology in concepts in Biotechnology by Balasubramaniam et al, Univ. Press, 1996.

Srabanti Basu

ourse Name : Biofertilizers and Biopesticides					
Course Code: BIOT3244					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

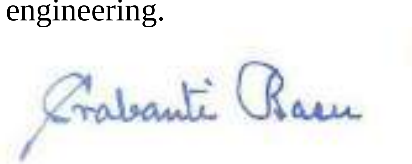
Course Outcomes:
After completing this course, students will be able to :

1. Explain the role of beneficial microbes in sustainable agriculture.
2. Gain knowledge on isolation and identification of nitrogen fixing bacteria.
3. Role of phophate solubilizing bacteria.
4. Understand molecular biology of nitrogen fixation.
5. Understand the importance of biopesticides over chemical pesticide.
6. Isolate and identify biopesticides for increased agricultural productivity.

Module-I Biofertlizers in agriculture [10L]
Definition of bio-fertilizers; composition and nutritional role based classification of different bio-fertilzers viz., composts – vermicompost and nitrogen fixers; basic knowledge and procedure of bacterial, fungal and composite bio-fertilizer production; role of *Azola, Tichoderma Cianobacteria, Trichogramma* in bio-fertilization; importance of bio-fertilizer used in agriculture; knowledge of bacterial and fungal suspensions as inocula and their preparations.

Module-II Biological nitrogen fixation [10L]
Basic outline of processes, characteristics and significance of biological nitrogen fixation (BNF) and phosphate solubilizing bacteria/ micro organisms (PSB and PSM) functioning; outline of biological nitrogen fixation from biochemical and biological points of view with special reference to different enzymes and other key role players; biological and biochemical process of symbiosis in nitrogen fixation by *Rhizobium* sp. with legume plants and others.

Module-III Molecular Biology of symbiotic Nitrogen fixer [10l]
Biological and biochemical process of symbiosis in nitrogen fixation by *Rhizobium* through root nodulation process and nitrogen fixation by it.
Brief concept of nod genes and nitrogen fixing genes (nif genes) --- their organization and role in the different steps of biological nitrogen fixation. Rhizosphere engineering.



Module-IV Biopesticides [10l]

Use of chemical pesticides and environmental effects, Definition and importance of biological pests and bio-pesticides in agriculture.

Brief conception of Integrated Pest Management (IPM), Integrated Pest and Disease Management (IDPM).

Advantages of bio-pesticides over chemical pesticides and developing them.

Types of Bio-pesticides with special reference to protein with anti-pest activity; gene from *Bacillus thuringenensis* and its proteins as biopesticide

Textbook

1. Stacey, Burris and Evans (ed), Biological Nitrogen Fixation, Chapman & Hall, 1992

References :

1. J K Ladha, M B Peoples, Management of Biological Nitrogen Fixation for the Development of More Productive and Sustainable Agricultural Systems, Springer.
2. P.S. Nutman, Symbiotic Nitrogen Fixation in Plants, Cambridge University Press
3. Sushil K Khetan, Microbial Pest Control, Marcel Dekker
4. Opender Koul, G S Dhaliwal, Microbial Biopesticides, Taylor & Francis

Subject Name: ANALYSIS OF STRUCTURES II
Subject Code: CIVL 3101
Contacts: 3L+1T
Credit: 4

Course Outcome:

On completion of the course, the students will be able to:

1. Apply the Slope Deflection and Moment Distribution Method to analyze indeterminate structures.
2. Develop and analyze the concept of suspension bridge and stiffness girders
3. Apply and analyze the concepts of curved beam analysis in hooks, rings and Bow girders.
4. Develop the concept bending in unsymmetrical beams.
5. Develop the fundamental concepts of plastic analysis using kinematic method and apply them in frames and continuous beam analysis.
6. Develop and analyze the portal frames using Portal and Cantilever method. Develop and analyze the indeterminate structures (continuous beams and frames) using flexibility and stiffness matrix method.

Sl. No.	Module	Details of Course content	Hours	Total
1.	I	Analysis of statically Indeterminate Structures: Moment distribution method-solution of continuous beam, effect of settlement and rotation of support, frames with or without side sway. Slope deflection method: method and application in continuous beams and frames. Suspension Bridge and stiffening girders.	6 4 2	42
2.	II	Curved Beam analysis: Hooks, rings and Bow girders. Unsymmetrical bending.	12	
3.	III	Plastic analysis of structures: beams and portal frames.	8	
4.	IV	Approximate method of analysis of structures: Portal and Cantilever methods. Matrix methods of structural analysis – Stiffness and flexibility approaches for analysis of beam.	4 6	

Text & References:

Sl.No	Name	Author	Publishers
1.	Basic Structural Analysis	C.S.Reddy	Tata Mc. Graw Hill
2.	Statically Indeterminate structures	C.K.Wang	Mc.Graw Hill
3.	Structural Analysis-A unified Classical and matrix approach.	A. Ghali and A.M. Neville	E & FN SPON
4.	Theory of structure	Timoshenko and Wang	Tata McGraw Hill

Tapas Saha

Subject Name: SOIL MECHANICS II

Subject Code: CIVL 3102

Contacts: 3L+1T

Credit: 4

Course Outcome:

After going through this course, the students will be able to:

1. Assess the compaction and consolidation characteristics of soil for solving geotechnical problems.
2. Calculate earth pressure on rigid retaining walls on the basis of classical earth pressure theories.
3. Analyze and design rigid retaining walls (cantilever types) from geotechnical engineering consideration.
4. Evaluate the bearing capacity of shallow foundation by applying established theory.
5. Estimate settlement in soils by different methods.
6. Compute safety of dams and embankments on the basis of various methods of slope stability analysis.

Sl. No.	Module	Details of Course Content	Hours	Total
1.	I	**Compressibility & Consolidation of Soil :-** Terzaghi's theory of one dimensional consolidation, Compressibility characteristics of soils, Compression index, Coefficient of compressibility and volume change, Coefficient of consolidation, Degree and rate of consolidation, Time factor, Settlement computation, Consolidometer and laboratory one dimensional consolidation test as per latest IS Code, Determination of consolidation parameters. **Compaction of Soil: -** Principles of compaction, Standard and modified proctor compaction test, Field compaction methods, Field compaction control, Factors affecting compaction, Effect of compaction on soil properties.	12	41
2.	II	**Earth Pressure Theories :-** Plastic equilibrium of soil, Earth pressure at rest, Active and passive earth pressures, Rankine's and Coulomb's earth pressure theories, Different types of backfill, Wedge method of analysis. Analytical and graphical methods for determination of earth pressure against various earth retaining structures. **Stability of retaining walls:** Cantilever retaining wall.	10	
3.	III	**Bearing capacity of shallow foundations :-** Bearing capacity, Definition, Factors affecting bearing capacity, Modes of failures, Methods of determining bearing capacity of soils. Terzaghi's bearing capacity theory, Effect of depth of embedment, Eccentricity of load, Foundation shape on bearing capacity, Effect of	11	

Tapas Sadhu

		water table and eccentric loads. Isolated footings with combined action of loads and moments, Bearing capacity as per IS: 6403.		
4.	IV	**Settlement:-** Allowable bearing pressure and settlement analysis (as per IS: 8009), Immediate and consolidation settlements, Rigidity and depth factor corrections, Settlement values as per IS: 1904 recommendations. **Stability of slopes :-** Types of failure, Analysis of finite and infinite slopes, Swedish and friction circle method, Ordinary method of slices, Factor of safety, Taylor’s stability number, Bishop’s simplified method of stability analysis.	8	

RECOMMENDED BOOKS:-

TEXT BOOKS:	
Sl. No.	Name
1.	Murthy, V.N.S., *Textbook of Soil Mechanics and Foundation Engineering* (Geotechnical Engineering Series), CBS Publishers and Distributors Pvt. Ltd.
2.	Punmia, B.C. and Jain A.K., *Soil mechanics and Foundations*. Laxmi Publications (P) Ltd.
3.	Das, B.M., *Principles of Geotechnical Engineering*, Thomson Brooks / Cole
4.	Gopal Ranjan & A.S.R. Rao, *Basic and Applied Soil Mechanics*, New Age International Pvt.Ltd, Publishers

REFERENCE BOOKS:	
Sl. No.	Name
1.	Lambe, T. W. and Whitman, R.V., *Soil Mechanics*, Wiley Eastern Ltd.
2.	Rao, A.V. and Venkatramaiah, R.C., *Numerical Problems - Geotechnical Engineering*, University press.
3.	Terzaghi, Peck and Mesri, *Soil Mechanics in Engineering Practice*, Wiley-Interscience.
4.	Alam Singh, Soil Engineering in Theory & Practice (Vol.1, 2 & 3), Jain Book Agency Publishers.

Subject Name: HIGHWAY & TRAFFIC ENGINEERING
Subject Code: CIVL 3103
Contacts: 3L+1T
Credit: 3

Course Outcome:

At the end of the course, the student will be able to:

1. Remembering the highway development in India including understanding the highway planning surveys & alignment.
2. Design highway geometrics.
3. Understanding the component parts of flexible and rigid pavement including the importance of soil & bitumen as pavement material.
4. Analyze and design flexible and rigid pavement (IRC Method).
5. Understand the principles of construction, maintenance and safety of highways.
6. Conduct traffic studies, analyze traffic data and design intersections including traffic signal and analyze parking & accidents.

SL. No	Module	Details of Course Contents	Hours	Total
1.	I	**Highway Network Planning**: Different modes of transportation, Role & Development of highway transportation, Classification, Network patterns, Planning surveys, Evaluation by saturation system, Introduction to highway economics. **Highway Alignment**: Factors controlling alignments, Principles of highway alignment, engineering surveys for highway alignment and location. **Highway Geometric Design**: Importance of geometric design, design controls, pavement cross-sectional elements, PIEV theory, Sight distance, Design of horizontal alignments, Design of vertical alignments, Geometric Design of Hill Roads.	2 2 8	42
2.	II	**Pavement Materials**: Types and component parts of pavement and their functions, highway and airport pavement materials, basic soil & aggregate properties relevant to pavement application, basic properties of bitumen and tar, Modified Bitumen (PMB, CRMB) tests on pavement materials, Use of geo-synthetics. **Design of Pavements**: Design factors, classification of axle types, contact pressure, EWLF & ESAL concept, Traffic analysis: vehicle damage factor. **Flexible Pavement Design**: Design of flexible pavements (GI method, CBR method, Triaxial method - only introduction), IRC method of design. **Rigid Pavement Design**: Design considerations, Westergaard's theory and assumptions, Design of dowel and tie bars, Joints in Rigid Pavements, IRC method of design.	4 8	

Tapas Saha

3.	III	**Highway Construction**: Construction of earth roads, gravel roads, WBM roads, Cement Concrete Pavements, Bituminous pavements. **Highway Maintenance**: Pavement failures, causes of failure, routine and periodic maintenance of highways. **Highway Drainage**: Importance of highway drainage, surface and sub-surface drainage, drainage of slopes and erosion control, road construction in water logged areas. **Highway Safety**: Introduction to highway safety, accident characteristics and factors, accident recording and analysis, road safety audit, safety education, traffic law enforcement, elements of highway safety management system, road safety management system.	2 2 2 2	
4.	IV	**Traffic Engineering**: Introduction, road users and vehicle characteristics, microscopic and macroscopic flow characteristics, time headways, interrupted and un-interrupted traffic, speed and travel time variation, travel time and delay studies, flow and density measurement techniques, highway capacity and level of service, level of service estimation, traffic signs. **Traffic Signal Design and Design of at grade Intersections**: Signal phasing, cycle length, fixed and vehicle actuated signal, Webster method, IRC method, signal co-ordination and problems on signal design, types of intersections, rotary and round-about, design aspects. **Parking and Accident Analysis**: Parking inventory study, on street and off street parking facilities, introduction to Intelligent Transport System, accident characteristics, accident recording and analysis.	4 4 2	

RECOMMENDED BOOKS:

TEXT & REFERENCE BOOKS	
Sl. No.	**Name of the books**
1.	High Way Engineering, Khanna& Justo, Nemchand& Brothers, Roorkee
2.	Principles of Transportation Engineering, P. Chakraborty& A. Das - PHI
3.	Transportation Engineering- C.J Khisty& B.K Lall., PHI
4.	Kadiyali L.R. Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, India, 1997
CODES FOR REFERENCE	
Sl. No.	**Name of the Codes**
5.	I.S Specifications on Concrete , Aggregate & Bitumen Bureau of Indian Standard
6.	Relevant latest IRC Codes (IRC-37 – 2001, IRC-37 – 2012, IRC 58 – 2011, IRC 73 - 1980, IRC 86 - - 1983, IRC 106 – 1990, IRC 64 – 1990, IRC 15-2002 - Indian Road Congress

Tapas Sadhu

Subject Name: ENVIRONMENTAL ENGINEERING

Subject Code: CIVL 3104

Contacts: 3L+1T

Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Identify the nature and quality of water & waste water as per its characteristics like physical, chemical & biological.
2. Estimate the future water demand by using various population forecasting methods.
3. Define & design in detail about the various water treatment units.
4. Define & design in detail about the various waste water treatment units.
5. Estimate the quantity of sewage produced and design the sewerage system.
6. Analysis and design of water distribution networks.

SL. No.	Module	Details of Course Content	Hours	Total
1	I	**Water Quality Parameter:** Physical and Chemical water quality parameters; Sources, impacts and methods of measurement	7	40
2	II	**Water Demand:** Per capita demand; Variations in demand; Factors affecting demand; Design period; Population Forecasting Methods. **Sources of water**: Surface and ground water. **Water Distribution:** Analysis of pipe networks by Hardy Cross Method, Storage and distribution of water; Estimation of reservoir capacity. **Water Treatment :** Typical flow chart for ground and surface water treatments; Unit Processes- Aeration, Plain sedimentation, coagulation & flocculation, Water Softening, Filtration, Disinfection.	15	
3	III	**Conveyance of Waste Water:** Definition of Common Terms, Quantity of sewage and storm sewage. **Sewer Design:** Hydraulic design of sewers, Analysis of partial flow diagrams and Nomograms.	8	
4	IV	**Wastewater Quality Parameters:** Physical, chemical and biological. **Wastewater treatment:** Typical flow chart for municipal wastewater treatment; Primary, Secondary & Tertiary Treatments: Unit Processes- Activated Sludge Process, Trickling Filter Process, Septic Tank, Advance Methods of Wastewater treatment.	10	

RECOMMENDED BOOKS:-

1. Water Supply & Sanitary Engineering. G. S. Birdie, Dhanpat Rai Publishing CO.
2. Environmental Engineering by P.V. Rowe, McGraw-Hill
3. Wastewater Engineering by Metcalf & Eddy, McGraw-Hill
4. Environmental Engineering, N. N. Basak, McGraw-Hill
5. Water Supply Engineering by Santosh Kr Garg, Khanna Publishers
6. Wastewater Engineering by B.C. Punmia & A.K. Jain, Laxmi Publications

Subject Name: DESIGN OF R.C.C. STRUCTURES
Subject Code: CIVL 3105
Contacts: 3L+1T
Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Understand material properties and design methodologies for reinforced concrete structures.
2. Assess different type of loads and prepare layout for reinforced concrete structures.
3. Identify and apply the applicable industrial design codes relevant to the design of reinforced concrete members.
4. Analyse and design various structural elements of reinforced concrete building like beam, slab, column, footing, and staircase.
5. Assessment of serviceability criteria for reinforced concrete beam and slab.
6. Prepare structural drawings and detailing and produce design calculations and drawing in appropriate professional format.

SL. No	Module	Syllabus	Hours	Total
1	I	**Introduction:** Principles of Design of Reinforced Concrete Members - Working Stress and Limit State Method of Design	2	42
		Basic concepts of Balanced, Under-reinforced and Over-reinforced Beam section by Working Stress Method and Limit State Method	1	
		Working Stress Method of Design: Analysis and Design of Beams and Columns.	4	
		Limit State Method of Design: Basic Concepts and IS Code Provisions (IS: 456 2000) for Design against Strength and Serviceability Limit States. Concepts of bond stress and development length; Use of 'design aids for reinforced concrete' (SP: 16).	4	
2	II	**Analysis, design and detailing** of singly reinforced rectangular, 'T', 'L' and doubly reinforced beam sections by limit state method.	5	
		Design and detailing of one-way and two-way slab panels as per IS code provisions	3	
		Design and detailing of continuous beams and slabs as per IS code provisions	3	

3	III	**Staircases:** Types; Design and detailing of reinforced concrete doglegged staircase	2	
		Design and detailing of reinforced concrete short columns of rectangular and circular cross-sections under axial load.	4	
		Design of short columns subjected to axial load with moments (uniaxial and biaxial bending) – using SP 16.	4	
4	IV	**Design and detailing** of reinforced concrete isolated square and rectangular isolated and combined footing for columns as per IS code provisions by limit state method	6	
		Design and detailing of Pile foundation as per IS code provisions.	4	

RECOMMENDED BOOKS:-

CODES:

1. IS: 456 - 2000
“Indian Standard for Plain and reinforced concrete – code of practice” Bureau of Indian Standard
2. SP: 16 Design Aid to IS 456

TEXT BOOKS:

1. Reinforced Concrete Design by Pillai and Menon
2. Reinforced concrete Design by S.N.Sinha
3. Limit State Design of Reinforced Concrete by P. C. Varghese

REFERENCE BOOKS:

1. Fundamental design of Reinforced concrete by N.C.Sinha & S.K. Roy

Tapas Saha

Subject Name: SOIL MECHANICS LAB I
Subject Code: CIVL 3111
Contacts: 3P
Credit: 2

Course Outcome

After going through this course, the students will be able to:

1. Identify different types of soil by visual inspection.
2. Determine natural moisture content and specific gravity of various types of soil.
3. Estimate in-situ density by core cutter method and sand replacement method.
4. Analyze grain size distribution and Atterberg limits for soil.
5. Perform laboratory tests to determine permeability and compaction characteristics of soil.
6. Prepare technical laboratory report.

List of Experiments:

1. Field identification of different types of soil as per Indian Standards [collection of field samples and identifications without laboratory testing].
2. Determination of natural moisture content.
3. Determination of specific gravity of cohesionless and cohesive soils.
4. Determination of in-situ density by core cutter method and sand replacement method.
5. Determination of grain size distribution by sieve and hydrometer analysis.
6. Determination of Atterberg limits (liquid limit, plastic limit and shrinkage limit).
7. Determination of co-efficient of permeability by constant and variable head permeability tests.
8. Determination of compaction characteristics of soil by standard proctor compaction test.

REFERENCES:

1. Soil Testing by T.W. Lamb (John Willey).
2. SP: 36 (Part - I and Part - II).
3. Soil Mechanics Laboratory Manual by Braja Mohan Das (Oxford university press).

Subject Name: **CONCRETE TECHNOLOGY LAB**
Subject Code: **CIVL 3112**
Contacts: 3P
Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Outline the importance of testing of cement and its properties
2. Assess the different properties of aggregate
3. Summarize the concept of workability and testing of concrete
4. Describe the preparation of fresh concrete
5. Describe the properties of hardened concrete.
6. Develop mix design of concrete as per provision of the IS Codes.

List of Experiments:

1. **Tests on cement** – specific gravity, fineness, soundness, normal consistency, setting time, compressive strength on cement mortar cubes.
2. **Tests on fine aggregate** – specific gravity, bulking, sieve analysis, fineness modules, moisture content, bulk density and deleterious materials.
3. **Tests on coarse aggregate -** specific gravity, sieve analysis, fineness modulus and bulk density.
4. **Tests on Fresh Concrete**: Workability: Slump, Vee-Bee, Compaction factor tests.
5. **Hardened Concrete**: Compressive strength on Cubes, Split tensile strength, Static modulus of elasticity, Flexure tests, Non destructive testing (Rebound hammer & Ultrasonic pulse velocity)
6. **Mix Design of Concrete**.

References:

1. Relevant latest IS codes on Aggregates, Cement & Concrete [269, 383, 2386, 10262(2009), SP23]
2. Laboratory manual of concrete testing by V.V. Sastry and M. L. Gambhir

Tapas Sadhu

Subject Name: ENVIRONMENTAL ENGINEERING LAB.

Subject Code: CIVL 3113

Contacts: 3P

Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Determine physical, chemical and biological characteristics of water and wastewater.
2. Determine optimum dosage of coagulant.
3. Assess the quality of water and wastewater.
4. To understand the different important water quality parameters, their relevance to human health and in treatment processes.
5. To know the permissible limits of different water quality parameter as per the standards.
6. Prepare technical laboratory report.

List of Experiments:

Experiment no.	Experiment name	Type of test
01	Determination of Color & Turbidity in an aqueous sample	Physical
02	Determination of pH and various solids (Total solids, Total suspended solids and Total dissolved solids) in an aqueous sample	
03	Determination of electrical conductivity and chloride in an aqueous sample	
04	Determination of Total & Phenolpthalein alkalinity in an aqueous sample and speciation of different alkalinities	Chemical
05	Determination of total and calcium hardness in an aqueous solution	
06	Determination of concentration of fluorides in an aqueous solution	
07	Determination of total and soluble iron of aqueous sample.	
08	Determination of the optimum coagulant dose for a given sample of water through Jar test	
09	Determination of chlorine demand of a contaminated water sample	
10	Determination of biochemical oxygen demand (BOD_5 at 20 deg C) for a given wastewater sample.	
11	Determination of chemical oxygen demand for a given wastewater sample.	
12	Determination of bacteriological quality of water : presumptive test, confirmative test and determination of Most Probable Number(MPN)	Bacteriological

Subject Name: **R. C. C. DESIGN & DETAILING**

Subject Code: **CIVL 3121**

Contacts: 3P

Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Understand material properties and design methodologies for reinforced concrete structures.
2. Assess different type of loads and prepare layout for reinforced concrete structures.
3. Identify and apply the applicable industrial design codes relevant to the design of reinforced concrete members.
4. Analyse and design various structural elements of reinforced concrete building like beam, slab, column, footing, and staircase.
5. Assessment of serviceability criteria for reinforced concrete beam and slab.
6. Prepare structural drawings and detailing and produce design calculations and drawing in appropriate professional format.

Course Details:

1. **General considerations**: Design principle of R.C.C. sections. Limit state method of design Loads and stresses to be considered in the design as per I.S. code provision. General Introduction to IS 1893-2002
2. **Design & detailing of a** Continuous T- Beam.
3. **Design & Detailing of** columns, isolated and combined footing
4. **Design & detailing of a** One way Continuous slab.
5. **Design of different units**: Slab, beam column, roofing and staircase from floor plan of a multistoried frame building, typical detailing of a two way floor slab.

References:

I.S- 456-2000, SP 34, SP 16, IS-875, IS 1893-2002
Standard text books of RCC design.

Subject Name: DESIGN OF STEEL STRUCTURES
Subject Code: CIVL 3201
Contacts: 3L + 1T
Credit: 4

Course Outcome:

After going through this course, the students will be able to:

1. Identify the material properties of structural steel. Moreover, the students will identify different bolted and welded connections, analyse and design them for axial and eccentric loads.
2. Design different steel sections subjected to axial compression and tension following Indian codes of practices.
3. Comprehend the differences between laterally supported and unsupported flexure members. Designing of the flexure members using Indian codes of practice.
4. Analyse and design rolled and built up compression members along with base connection subjected to axial compression, bending and tension.
5. Calculate shear force and bending moment on rolled and built up girders, dimension the section and finally design it following Indian standard design guidelines.
6. Identify different components of gantry system, calculate lateral and vertical loads acting on the system, dimension the components and design them.
7. Design different components of an industrial building.

Sl. No.	Module	Details of Course Content	Hours	Total
1	I	**Materials and Specification**: Rolled steel sections, mechanical properties of steel and their specifications for structural use. Codes of practices. **Structural connections:** Bolted and welded connections: Introduction to different types of connectors, types of bolted and welded joints, assumptions, failure and efficiency of joints. Design of bolted and welded connections for axial load, torsion and shear, tension and shear, interaction check. High strength friction grip bolted joints.	8	42
2	II	**Tension members**: Working stress and limit state design of tension members, I.S code provisions, design rules, examples. **Compression members**: Effective lengths about major and minor principal axes, I.S code provisions. i) Design of axially loaded compression member: Working stress and limit state design of axially loaded compression members using rolled steel and built up sections.	13	

		Examples. ii) Design of beam – column: Design of rolled steel and built up columns under eccentric loading, design of lacing and batten plates. Design of column bases: Design of slab base, gusseted base, connection detailing.		
3	III	**Beams:** Working stress and limit state design in bending, compression and tension. Design of rolled steel sections, plated beams, concepts of curtailment of flanges. **Plate girders**: Design of web, flanges and stiffeners. Splices and connections using bolts and welding.	13	
4	IV	**Gantry system**: Design gantry girder and gantry column considering I.S code provisions.	8	

Text and References:

Sl. No	Name	Author	Publishers
1.	Design of steel structures	N. Subramanian	Oxford University Press
2.	Design of steel structures	A.S. Arya and J.L. Ajmani	Nemchand and Bros.
3.	Limit state design of steel structures (2nd edition)	S.K. Duggal	McGraw Hill India, New Delhi.
4.	Fundamentals of structural steel design	M.L. Gambhir	McGraw Hill India, New Delhi
5.	Analysis and design of steel structures, 2nd ed.	Karuna Moy Ghosh	Prentice Hall, India

Reference code: IS: 800 – 2007, SP 6 (I) – 1964.

Subject Name: FOUNDATION ENGINEERING
Subject Code: CIVL 3202
Contacts: 3L
Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Determine the load carrying capacity of pile foundation.
2. Compute the efficiency and settlement of pile group.
3. Understand different subsoil exploration methods and interpret field and laboratory test data to obtain design parameters for geotechnical analysis.
4. Correlate bearing capacity of shallow foundation from field test data.
5. Analyze and design sheet pile structure on the basis of earth pressure theories.
6. Understand and apply various types of ground improvement methods for solving complex geotechnical problems.

Sl. No.	Module	Details of Course Content	Hours	Total
1.	I	**Foundations: -** Classification, selection- shallow and deep foundations. **Deep foundations:- Pile foundation:** Types of piles, material, Suitability and uses, Method of installation of piles - classification of piles based on material, Installation Techniques – Selection and uses, Determination of types and lengths of piles, Load transfer mechanism, Determination of load carrying capacities of piles by static and dynamic formulae as per IS codes, Pile spacing and group action, Group efficiency, Negative skin friction, Pile load test, Settlement of pile group, Lateral load capacity of pile by IS: 2911 and Reese & Matlock methods, Uplift capacity of pile - introduction.	14	40
2.	II	**Site Investigation & Soil Exploration:-** Planning of sub-surface exploration, Methods of boring, sampling, Different types of samples, Spacing, Depth and number of exploratory borings, Bore log, Preparation of sub-soil investigation report. **Insitu tests:-** Standard penetration test, Static cone penetration test, Dynamic cone penetration test, Field vane shear test, Plate load test. **Indirect methods of soil exploration:-** Geophysical method: seismic refraction and electrical resistivity methods.	9	
3.	III	**Shallow Foundations:-** Bearing Capacity from SPT, SCPT and Plate load Test data.	9	

Tapas Saha

		Sheet pile structures: - Type of sheet pilling, Design of sheet pile, Cantilever sheet piling, Anchored sheet piling, Free earth and fixed earth support methods, Analysis with anchored bulk heads.		
4.	IV	**Introduction to Ground Improvement Techniques:-** Introduction, Economic considerations, Consolidation by preloading and sand drains, Stone columns, Compaction by vibrofloatation, Grouting techniques and principles, Applications of geosynthetics, Ground anchors and soil nailing.	8	

Recommended books:-

TEXT BOOKS:	
Sl. No.	**Name**
1.	Murthy, V.N.S., *Textbook of Soil Mechanics and Foundation Engineering* (Geotechnical Engineering Series), CBS Publishers and Distributors Pvt. Ltd.
2.	Das, B.M., *Principles of Foundation Engineering*, Thomson Brooks / Cole
3.	Punmia, B.C. and Jain A.K., *Soil mechanics and Foundations*, Laxmi Publications (P) Ltd.
4.	Das, B.M., *Principles of geotechnical Engineering*, Thomson Brooks / Cole

REFERENCE BOOKS:	
Sl. No.	**Name**
1.	Bowels, J.E. *Foundation Analysis & Design*, Mc Graw Hill
2.	Rao, A.V. and Venkatramaiah, R.C., *Numerical Problems- Geotecnical Engineering*, University press.
3.	Terzaghi, Peck and Mesri, *Soil mechanics in engineering practice*, Wiley-Interscience.
4.	Alam Singh, Soil Engineering in theory & Practice (Vol.1, 2 & 3), Jain Book Agency Publishers.

Subject Name: PRESTRESSED CONCRETE
Subject Code: CIVL 3203
Contacts: 3L + 1T
Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Learn the introduction of prestressed concrete member and its deflection properties
2. Develop the design criteria of prestressed concrete section for flexure and shear properties
3. Analyze the anchorage zone stress for post-tensioned members
4. Impart knowledge regarding the methods of Analysis of Statically Indeterminate Structures.
5. Impart knowledge regarding the composite construction of Prestress and In-situ concrete.
6. Impart knowledge regarding Design of Prestressed concrete poles and sleepers and introduction of partial prestressing.

SL. No	Module	Syllabus	Hours	Total
1	I	**Introduction of Prestressed Concrete**: Materials, Prestressing System, Advantages of Prestressing, Analysis of Prestress and Bending Stress, Losses	8	42
		Deflections of Prestressed Concrete Members: Importance, Factors, Short term and Long term Deflection	4	
2	II	**Shear and Torsional Resistance**: Design of Shear Reinforcement, Design of Reinforcement for Torsion, Shear and Bending.	6	
		Limit State Design Criteria: Inadequacy of Elastic and Ultimate Load Method, Criteria for Limit States, Strength and Serviceability.	2	
		Design of Prestressed Concrete Section: for Flexure & methods by Lin and Magnel	4	
3	III	**Anchorage Zone Stresses in Post Tensioned Members**: Stress Distribution in End Block, Anchorage Zone Reinforcement	4	
		Statically Indeterminate Structures: Advantages of Continuous Member, Effect of Prestressing, Methods of Achieving Continuity and Method of Analysis of Secondary Moments	6	
4	IV	**Composite Construction of Prestressed and In-situ Concrete**: Types, Analysis of Stresses	4	
		Prestressed Concrete Poles and Sleepers: Design of Sections for Compression and Bending. Introduction to Partial Prestressing.	4	

Tapas Sadhu

Recommended books:-

Code: IS 1343:1980

Text Books:

1. Prestressed Concrete, Fourth Edition, N Krishna Raju McGraw Hill
2. Fundamentals of Prestressed Concrete, N.C.Sinha and S.K.Roy
3. Prestressed Concrete, S.Ramamurthan

Reference Books:

1. Design of Prestressed Structures, T.Y.Lin and N.H.Burns, Wiley Eastern Ltd.

Subject Name: DATA STRUCTURE & RDBMS

Subject Code: CSEN 3206

Contacts: 3L

Credit: 3

Module I: (11L)

Linear Data structures:
Singly Linked List- Insertion at beginning, at end and any position of the List. Deletion by value, by position: beginning, end and any position of the List
Stack and Queue: Both array and Linked Representation, Circular queue using array only.
Application of stack: Infix to postfix conversion, Evaluation of postfix expression.

Module II: (10L)

Recursion: Design of Recursive algorithm.
Non-Linear Data Structures:
Trees: Binary Trees: Array and Linked representation, Binary tree Traversal Techniques, reconstruction of binary tree using traversal sequence.
Binary Search Trees - Insertion and Deletion algorithms.
Sorting Algorithms: Bubble sort, Insertion sort, Selection sort, Quick sort and their comparison.
Searching Algorithms: Linear search, Binary search and their comparison.

Database Concept

Module III: (10L)

Introduction to Database Concepts, File Processing System and Database Management System, DBMS Architecture and Data Independence.
Data Model: Basic Concepts, Entity-Relationship Diagram, Keys, Cardinality, Weak Entity Set.
Introduction to relational algebra & SQL: Operators like select, project, rename, Cartesian product, join, union, intersect, minus, DDL, DML.

Module IV: (10L)

Relational Database Design: Functional Dependencies, Normalization: Different anomalies in database designing
1NF, 2NF, 3NF and BCNF.
Introduction to Transaction Processing Concepts: ACID properties, Serializability and Recoverability

Text Books:

Data Structures:

I) Title: Data Structures.
Author: Seymour Lipschutz.
Publication: Tata McGraw-Hill (India)

II) Title: Data Structures and Program Design in C.
Author: Kruse Robert L., Robert Kruse, Cl Tondo.
Publication: Pearson Education India.

Database Concept:

I) Title: Fundamentals of Database Systems
Author: Elmasri Ramez and Navathe Shamkant
Publication: Pearson.

II) Title: Database System Concepts
Author: A. Silberschatz, H.F Korth, S.Sudarshan
Publication: McGraw Hill Education (India) Private Limited

Reference Books:

Data Sturucture:

I) Title: Data Structures using C.
Author: Tanenbaum A. S, Langsam Y., Augenstein M. J.
Publication: Pearson.

II) Title: The Art of Computer Programming
Author: Donald E. Knuth
Publication: Addison-Wesley Professional

Database Concept:

I) Title: Introduction to Database Management Vol. I, II, III,
Author: Date C. J.
Publication: Addison Wesley.

II) Title: Principles of Database Systems
Author: Ullman JD.
Publication: Galgottia Publication

Subject Name: RAILWAY & AIRPORT ENGINEERING
Subject Code: CIVL 3231
Contacts: 3 L + 1 T
Credit: 3

Course Outcome:

At the end of the course, the student will be able to:

1. Understand the importance of railway infrastructure, planning & design and identify the factors governing the design.
2. Understand the function of various permanent way components and design railway geometrics & turnouts.
3. Calculate tractive effort & platform height and understand the function of signaling & interlocking.
4. Get an idea about components of aircraft, airport planning and obstruction.
5. Design Runways and Taxiways.
6. Have a brief knowledge of airport layout, airport drainage and airport marking & lighting.

SL. No	Module	Details of Course Contents	Hours	Total
1.	I	**Railways in India**: *Introduction* - Role of Indian railways in National Development, Railways for urban transportation. *Alignment of Railway Lines* - Location survey, Engineering surveys for track alignment- Obligatory points, Conventional and modern methods. (Remote sensing, GIS). **Permanent Way components and Functions**: Rails- Types of rails, Rail fastenings, Concept of gauges, Coning of wheels, Sleepers- Functions, Materials, Density, Ballast - Functions, Materials, Ballast less tracks. **Geometric Design of railway tracks**: Grade compensation and gradient, Widening of gauges in curves, Super elevation, Horizontal, Vertical and Transition curves.	2 8 4	42
2.	II	**Track Maintenance**: Points and Crossings- Design of Turnouts, Working principles, Various types of track junctions. **Rolling Stock, Railway Section and Yards**: Rolling Stock. Tractive power, Track resistance, Layouts of railway stations and yards, Re-laying of tracks, Level crossings. **Signalling and Interlocking**: Signalling, Interlocking and Track circuiting- Construction and Maintenance. **Design of tracks for high speed**: Geometrical requirements, Ballasted or Ballast less, Design methodology, Maintenance considerations.	2 2 2 2	
3.	III	**Aircraft component and Airport planning**:		

Tapas Saha

		Component parts and its function, aircraft characteristics and their influence on airport planning, air traffic characteristics, development of new airports, factors affecting airport site selection, Airport Maintenance. **Airport obstruction**: Zoning laws, classification of obstructions, imaginary surfaces, approach zones, turning zones. **Design of Runway and Taxiway**: Runway orientation, wind rose diagrams, basic runway length, corrections for runway length, airport classification, geometric design, airport capacity, runway configuration, taxiway design, geometric standards, exit taxiways, holding aprons, location of terminal buildings, aircraft hangers parking.	2 4 6	
4.	IV	**Terminal area & airport layout**: Terminal area, planning of terminal buildings, apron, size of gate position, number of gate position, aircraft parking system, hanger, general planning considerations blast considerations. **Airport drainage**: Requirement of airport drainage, design data, surface drainage design. **Airport marking and lighting**: Marking lighting of runways, taxiway, approach other areas.	2 2 2	

RECOMMENDED BOOKS:

TEXT AND REFERENCE BOOKS	
Sl. No.	Name of the books
1.	A Text Book of Railway Engineering, S.P. Arora& S.C. Saxena
2.	Railway Engineering, Satish Chandra, Oxford University press
3.	Airport planning and Design, S.K.Khanna&M.G.Arora
4.	Airport Transportation Planning & Design-. Virendra Kumar &Satish Chandra, Galgotia Publication Pvt. Ltd., New Delhi

Tapas Saha

Subject Name: ADVANCED SURVEYING

Subject Code: CIVL 3232

Contacts: 3 L + 1 T

Credit: 3

Course Outcome:

After successful completion of the course student will be able to:

1. Record the accurate and thorough data from the field work, for documentation.
2. Analyse the data from the records of the Global Positioning System, Geographic Information System and Remote Sensing.
3. Employ the knowledge to use modern survey equipment to measure angles and distances with accuracy considering the curvature of the earth.

SL. No	Module	Details of Course Content	Hours	Total
1	I	**Setting out works** Laying out of building, setting out of Culverts, setting out of Bridges, setting out of Tunnels. **Tacheometry** Concepts of anallactic lens, Stadia systems, movable hair stadia method, calculation of horizontal and vertical distance using tachometer.	10	40
2	II	**Geodetic survey** Concepts of triangulation and triangulation systems in brief, order of triangulation, strength of figures. **Astronomical survey** Spherical trigonometry, Celestial sphere, Coordinate systems-Altitude and Azimuth systems, Declination-Hour Angle system, application of astronomical survey.	10	
3	III	**Aerial surveying** Terrestrial photogrammetry, aerial photogrammetry, photo interpretation, Parallax. **Curve surveying** Elements and setting out of compound curves, reverse curve and vertical curves.	10	
4	IV	**Theory of errors and adjustments** Direct and indirect observations, sources of errors, types of error, elimination of errors, error propagation, method and application of error adjustment. **Remote Sensing** Introduction, historical perspective, uses, basic Principles, types, Platforms and Satellites, Sensors, Spectral Bands, Spectral reflectance curves. **Geographic Information Systems** Introduction, Data, Information Systems and Planning, GIS subsystems.	10	

Tapas Saha

Recommended books:-

TEXT BOOKS:

1. Punmia B.C., Jain A.K. and Jain A.K. Higher Surveying (Vol-3). 15th edition, LaxmiPublications (P) Ltd.

REFERENCE BOOKS:

1. Subramanian R. Surveying and Levelling. 2nd editon, Oxford university Press
2. Satheesh Gopi, R. Sathikumar, and N. Madhu, Advanced Surveying: Total Station, GIS and Remote Sensing (English) 1st Edition, Pearson
3. W. Norman Thomas., Surveying, Edward Arnold, 1920.

Subject Name: DESIGN OF TALL STRUCTURES

Subject Code: CIVL 3233

Contacts: 3 L + 1 T

Credit: 3

Course Outcome:

After attending the course, students will be able to:

1. Understand the advanced methods of analysis and design of high rise structures.
2. Design high rise structures such as multistoried buildings, chimney structures etc.
3. Analyse the static as well as dynamic effect of seismic and wind on tall structures.

SL. No	Module	Details of Course Content	Hours	Total
1	I	**INTRODUCTION** Concept of tall buildings, factors affecting growth, height and structural forms. Tall building structure- design process, strength and stability, stiffness and drift limitation, creep, shrinkage and temperature effects. **BASIC STRUCTURAL FORMS** Braced frame structures, rigid frame structures, in filled frame structure, flat plate and flat- slab structures, shear wall structures, wall- frame structures, framed-tube structures, outrigger –braced structures, suspended structures, core-structures, space and hybrid structures. Modelling concept of 2D and 3D structures, exposure to the design philosophy of Staad software.	10	44
2	II	**WIND ANALYSIS** Design considerations for nature of wind, use of Gust Factor Method to assess the dynamic effect of wind on structures. Introductory concept of wind tunnel test, objectives of wind tunnel tests.	10	
3	III	**SEISMIC ANALYSIS** Tall building behaviour during earthquakes, use of Response Spectrum Method to assess the dynamic effect of earthquake on structures. Basic concept of Time History Analysis.	12	

4	IV	**DESIGN PHILOSOPHY OF A TALL BUILDING WITH SHEAR WALLS** Concept of P-delta effects. Concepts of ductile detailing of building, referring to IS 13920-1993. Detailed concept of shear wall design for a Tall building.	12	

Recommended books:-

TEXT BOOKS:

1. Bryan S. Smith and Alex Coull., *Tall Building Structures: Analysis and Design*, John Wiley & Sons, Inc, New York, 1991.
2. Agarwal P and Shrikhande M., *Earthquake Resistant Design of Structures*, PHI Learning Pvt. Ltd, 2006.
3. Manohar, S.N., "Design and Construction of Tall Chimneys", McGraw-Hill Book Co., New York, 1972.

REFERENCE BOOKS:

1. Taranath B.S., *Structural Analysis and Design of Tall Buildings- Steel and Composite Construction*, CRC Press, 2012.
2. Sarkisian M., *Designing Tall Buildings- Structure as Architecture*, Routledge, 2012
3. Parker D and Wood A., *The Tall Buildings-Reference Book,* Routledge, 2013.

CODES:

IS 875 (Part-3): 1987, IS 1893 (Part-1): 2002, IS 1893 (Part 4): 2005, IS 4998 (Part 1): 1992, IS 13920: 1993.

Tapas Sadhu

Subject Name: SOIL STABILIZATION & GROUND IMPROVEMENT TECHNIQUES
Subject Code: CIVL 3234
Contacts: 3 L + 1 T
Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Understand soil stabilization using cement, lime and flyash for various critical geotechnical problems.
2. Illustrate in-situ densification techniques applied to both cohesionless and cohesive soils.
3. Examine different types of geotextiles on the basis of its properties and applications.
4. Interpret functions of geotextiles with its applications.
5. Apply the knowledge of grouting for various field applications.
6. Review the methods of soil stability such as reinforced earth, soil nailing, underpinning etc.

Sl. No.	Module	Details of Course Content	Hours	Total
1.	I	**Soil Stabilization**:- Introduction, Stabilization of soil with and without granular skeleton, Common nomenclature of stabilized soil systems and stabilization methods, Specific methods of soil stabilization: stabilization with cement, lime and fly-ash.	10	38
2.	II	**In-situ densification**: - Introduction, Compaction methods and controls, Densification of granular soil, Impact at ground surface, Vibrofloatation. Densification of cohesive soils, Preloading and dewatering, Design of sand drains and stone columns, Electrical and thermal methods.	10	
3.	III	**Geotextile**:- Over view, Classification of geotextile, Geotextile as separator and reinforcement, Geotextile in filtration and drainage, Geotextile in erosion control, Natural and artificial geotextiles.	8	
4.	IV	**Grouting**: - Over view, Grouting equipments and methods, Grout design and layout, Grout monitoring schemes. **Soil stability**: - Reinforced earth fundamentals, Soil nailing, Soil and rock anchors, Underpinning.	10	

Recommended books:-

TEXT BOOKS:	
Sl. No.	**Name**
1.	Bowels, J.E., *Foundation Analysis and Design*, Mc Graw Hill
2.	Das, B.M., *Principles of Foundation Engineering*, Thomson Brooks / Cole
3.	Koerner, R.M., *Construction and Geotechnical methods in foundation engineering*, Mc Graw Hill
REFERENCE BOOKS:	

Tapas Saha

Sl. No.	Name
1.	Ingold, T. S., *Reinforced Earth*, Thomas Telford.
2.	Koerner, R. M., *Designing with Geosynthetics*, Prentice Hall
3.	Saran, S., *Reinforced soil and its engineering application*, I. K. International Publishing House.

Subject Name: SOIL MECHANICS LAB II

Subject Code: CIVL 3211

Contacts: 3P

Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Estimate compressibility characteristics of soil.
2. Determine shear strength parameters of soil by unconfined compression test and vane shear test.
3. Determine shear strength parameters of soil by direct shear test.
4. Perform triaxial test to determine shear strength parameters of soil.
5. Determine California Bearing Ratio (CBR) of soil.
6. Prepare technical laboratory report.

List of Experiments:

1. Determination of compressibility characteristics of soil by oedometer test.
2. Determination of unconfined compressive strength of soil by unconfined compression test.
3. Determination of shear strength parameters of soil by direct shear test.
4. Determination of undrained shear strength of soil by vane shear test.
5. Determination of shear strength parameters of soil by unconsolidated undrained triaxial test.
6. Determination of California Bearing Ratio (CBR) of soil.
7. Determination of relative density of soil.
8. Standard Penetration Test.

REFERENCES:

1. Soil Testing by T.W. Lamb (John Willey).
2. SP: 36 (Part - I and Part - II).
3. Soil Mechanics Laboratory Manual by Braja Mohan Das (Oxford university press).

Subject Name: TRANSPORTATION ENGINEERING LAB

Subject Code: CIVL 3212

Contacts: 3P

Credit: 2

Course Outcomes:

After going through this course, the students will be able to:

1. Access the quality of different bitumen grade.
2. Characterize the pavement materials.
3. It will help the students to gather knowledge about the quality control techniques of various aggregates and pavement materials.
4. Enable the students to characterize bituminous grade according to their work suitability.
5. Recognize the knowledge and idea about the different physical properties of aggregates by performing different test on aggregates.
6. Prepare technical laboratory report.

List of Experiments:

A. Test on Highway Materials:

1. Aggregates –
    a) Impact Value Test.
    b) Los Angeles Abrasion Value Test.
    c) Water Absorption and Specific Gravity.
    d) Elongation and Flakiness Index.
2. Bitumen –
    a) Specific Gravity Test.
    b) Penetration Value Test.
    c) Softening Point Test.
    d) Loss on Heating Test.
    e) Flash and Fire point Test.
    f) Ductility Test.
    g) Viscosity Test.

B. Bituminous Mix Design by Marshall Stability Method.

C. Stripping Value Test.

D. Benkelman Beam Deflection Test.

References:

1. BIS Codes on Aggregates and Bituminous Materials.
2. Highway Material Testing (Laboratory Manual) by S.K. Khanna and CE. G. Justo.
3. Relevant IS and I.R.C codes.

Subject Name: RDBMS Lab

Subject Code: CSEN 3216

Contacts: 3P

Credit: 2

Experiments on Database on RDBMS Platform (Oracle):

DDL Commands: Creating Tables along with constraints like: Primary Key, Foreign Key, unique, Not Null, Check. Altering Table Structure like adding and modifying constraints, adding and modifying column data types, etc.

DML: Inserting rows, Updating rows, Deleting rows

SQL Query: Cartesian Product, All types of Join, Union, Intersect, Minus, Single Row functions, multiple row functions using GROUP BY clause, ORDER BY Clause, Nested Sub-Queries

Introduction to PL/SQL: Programming Language Constructs in PL SQL like variable declaration, Conditional Statements, different types of loop structures, functions, etc. Programming using Cursors.

Books:

DBMS Laboratory

Title: SQL, PL/SQL: The Programming Language Of Oracle (With CD-ROM) (English) 4th Revised Edition

Author: Ivan Bayross

Publisher: BPB Publications

Subject Name: STEEL STRUCTURE DESIGN & DETAILING
Subject Code: CIVL 3221
Contacts: 3P
Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Identify the material properties of structural steel. Moreover, the students will identify different bolted and welded connections, analyse and design them for axial and eccentric loads.
2. Design different steel sections subjected to axial compression and tension following Indian codes of practices.
3. Comprehend the differences between laterally supported and unsupported flexure members. Designing of the flexure members using Indian codes of practice.
4. Analyse and design rolled and built up compression members along with base connection subjected to axial compression, bending and tension.
5. Calculate shear force and bending moment on rolled and built up girders, dimension the section and finally design it following Indian standard design guidelines.
6. Identify different components of gantry system, calculate lateral and vertical loads acting on the system, dimension the components and design them.
7. Design different components of an industrial building.

List of topics:

I) Problems on general consideration and basic concepts
II) Discussion on different loads (i.e. Dead load, live load, wind load and others) as per IS 875.
III) Introduction to PEB (pre-engineered building) structures.
IV) Design and drawing of the following components of a factory shed:

1. Members of the roof truss.
2. Joints of the roof truss members.
3. Purlins.
4. Wind bracings.
5. Columns.
6. Gantry girder and gantry column.
7. Column base connection.

References: I.S. 875 (part I, II and III) - 1987, I.S: 800-2007, SP: 6 (I) – 1964.

Text & References:

Sl. No	Name	Author	Publishers
1.	Design of steel structures.	N. Subramanian	Oxford University Press
2.	Design of steel structures.	A.S.Arya and J.L.Ajmani	Nemchand and Bros.
3.	Limit State design of steel structures (2nd edition).	S.K.Duggal	McGraw Hill India, New Delhi
4.	Fundamentals of structural steel design.	M.L. Gambhir	McGraw Hill India, New Delhi
5.	Analysis and design of steel structures (2nd edition).	Karuna Moy Ghosh	Prentice Hall, India

Tapas Saha

Object Oriented Programming using C++ [Code: CSEN3004] Contact: 3L Credits: 3

Module-A:

- **Overview of Object Oriented Concepts** **[2L]**
  - Difference between OOP and other conventional programming – advantages and disadvantages
  - Class, object, message passing, inheritance, encapsulation, polymorphism
- **Basic Programming with C++** **[6L]**
  - Data Types, Operators
  - Control Statements and Loops
  - Functions and Parameters
  - Arrays, Pointers and References
  - String Manipulation

Module-B:

- **Classes and Objects** **[10L]**
  - Fundamentals of Class and Object
  - Abstraction, Encapsulation, Access Specifier
  - Static Member and Friend Function
  - Constructor and Destructor

Module-C:

- **Overloading and Inheritance** **[8L]**
  - Function Overloading
  - Operator Overloading
  - Inheritance
  - Derived Class
- **Polymorphism and Overriding** **[4L]**
  - Abstract Class
  - Runtime Polymorphism
  - Virtual Base Class
  - Overriding

Module-D:

- **Exception Handling** **[2L]**
- **Namespace** **[2L]**
- **Templates** **[4L]**
  - Class Template
  - Function Template

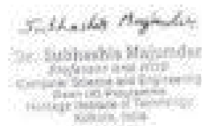
Textbooks / References:

1. Bjarne Stroustrup – "The C++ Programming Language" – Pearson
2. E Balagurusamy – "Object Oriented Programming with C++" – 6th Edition – McGraw Hill
3. Robert Lafore – "Object-oriented Programming in C++" – SAMS Publishing
4. Steve Oualline – "Practical C++ Programming" – O'Reilly
5. James Rambaugh & Michael Blaha – "Object Oriented Modeling and Design" – Prentice Hall, India

Object Oriented Programming Lab **[Code: CSEN3014]** **Contact: 2P** **Credits: 1**

Assignments on: *[based on Lectures]*

1. Basic Programming
2. Class
3. Constructor
4. Overloading
5. Inheritance
6. Polymorphism
7. Overriding
8. Exception Handling
9. Templates



Note: *use C++ for programming to carry out assignments based on lectures*

Course Name : RDBMS LABORATORY					
Course Code: CSEN 3216					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

1. To give a good formal foundation on the relational model of data.
2. To present SQL and procedural interfaces to SQL comprehensively
3. To give an introduction to systematic database design approaches covering conceptual design, logical design and an overview of physical design.
4. To present the concepts and techniques relating to query processing by SQL engines.
5. To present the concepts and techniques relating to ODBC and its implementations.
6. To introduce the concepts of transactions and transaction processing.

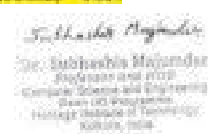
Experiments on Database on RDBMS Platform (Oracle):

DDL Commands: Creating Tables along with constraints like: Primary Key, Foreign Key, unique, Not Null, Check. Altering Table Structure like adding and modifying constraints, adding and modifying column data types, etc.

DML: Inserting rows, Updating rows, Deleting rows.

SQL Query: Cartesian Product, All types of Join, Union, Intersect, Minus, Single Row functions, multiple row functions using GROUP BY clause, ORDER BY Clause, Nested Sub-Queries.

Introduction to PL/SQL: Programming Language Constructs in PL SQL like variable declaration, Conditional Statements, different types of loop structures, functions, etc. Programming using Cursors.



Books:

DBMS Laboratory

Title: SQL, PL/SQL: The Programming Language Of Oracle (With CD-ROM) (English) 4th Revised Edition

Author: Ivan Bayross

Publisher: BPB Publications

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Detailed syllabus of 7th semester

Course Name : Compiler Construction					
Course Code: CSEN4101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**3**

Module 1: **[10L]**

A) Introduction to Compiling: Analysis of the source program; The phases; Cousins of a compiler. (2L)

B) A simple One-pass Compiler (4L)

C) Lexical Analysis*:* The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of tokens. A language for specifying lexical analyzer; Design of a lexical analyzer generator (Lex / Flex). (4L)

Module 2: **[13L]**

A) Syntax Analysis: The role of a parser, Context free grammars, Writing a grammar.
Top down Parsing, Non-recursive Predictive parsing (LL(1)).
Bottom up parsing, Handles, Viable prefixes, Various forms of LR parsers :SLR(1), LR(0), LR(1), Construction of LALR(1) parsing table using / avoiding LR(1) parsing tables.
Parser generators (yacc / Bison). (7L)

B) Type Checking: Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions. (2L)

C) Run-Time Environment:
Source Language Issues: Procedures, Activation Trees, Control stacks, Scope of variable declarations, Binding of names.
Storage Organization: Sub-division of Run time memory, Activation Records.
Storage Allocation strategies: Static allocation / stack allocation / heap allocation.
Scope: Blocks, With or Without Nested Procedures, Access Links, Displays.
Parameter passing.
Symbol tables: organization; data structures used. (4L)

Module 3: **[8L]**

B) Syntax Directed Translation:
Syntax directed definitions: Synthesized attributes, Inherited attributes.
Construction of Syntax trees: Expressions, DAG for Expressions.
Bottom-up Evaluation of S-Attributed Definitions: Synthesized attributes on the Parser stack.
L-Attributed definitions: Translation schemes.
Top-down Translation: Elimination left recursion.
Bottom-up Evaluation of Inherited Attributes: Removing Embedding actions, Inheriting attributes, Simulating the Evaluation of Inherited attributes, Replacing Inherited by Synthesized attributes. (3L)

C) Intermediate Code Generation:
Intermediate Languages: Graphical representation,
Three-address code: different types, Translation into Three-address code, Quadruples / Triples / Indirect Triples, their comparisons.
Translation of Declarations statements: Procedures, Records.
Assignment statements.
Addressing array elements.
Boolean expressions, Flow of control statements, Case statements.
Backpatching: Boolean expression, Flow-of-control statements.
Procedure calls. (5L)

Module 4: **[9L]**

A) Code generation:

Issues in the design of a code generator: Memory management; Instruction selection;
The target machine.
Run-time storage management.
Basic blocks and flow graphs: Transformations on basic blocks; Flow graphs; Loops;
A simple code generator: Algorithm; Conditional statements;
Register allocation and assignment.
The DAG representation of basic blocks. (5L)

B) Code optimization:

Principal source of optimization: common subexpression, Copy propagation, Dead – code elimination,
Loop optimization, Code motion, Induction variables.
Loops in flow graphs: Dominators, Natural loops, Inner loops.
Peephole optimization. (4L)

References :

[1] Aho, Sethi, Ullman: Compilers: Principles, Techniques and Tools: 1st Edition, Pearson Education.
[2] Holub - "Compiler Design in C" – PHI
[3] Tremblay and Sorenson Compiler Writing-McgrawHill International .
[4] Chattopadhyay , S- Compiler Design (PHI)

Course Outcome:

- On completion this course, students are expected to have an overview of how a real life compiler works across various phases.
- Besides this students should be able to understand various necessary tasks related to compilers like token identification, grammar writing, type conversion and storage management.
- Also students will learn to generate intermediate codes, generate actual machine codes targeting a particular architecture and optimize generated code across various phases of the compilation process.

OPTIONS FOR ELECTIVE II

CSEN 4141 Information Retrieval
CSEN 4142 Advanced Operating System
CSEN 4143 Computational Geometry
CSEN 4144 Data Mining and Knowledge Discovery
CSEN 4145 Cloud Computing

Course Name : Information Retrieval					
Course Code: CSEN 4141					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module-1: [9L]

Introduction [2L]: Introduction to Information Retrieval, Goals and history of IR (Information Retrieval), The impact of the web on IR.

Basic IR Models [4L]: Boolean model, Vector Space Model, Probabilistic information retrieval models ; ranked retrieval; text-similarity metrics; TF-IDF (term frequency/inverse document frequency) weighting; cosine similarity.

Basic Tokenizing, Indexing and Implementation of Vector-Space Retrieval [3L]:
Simple tokenizing, stop-word removal, and stemming; inverted indices; efficient processing with sparse vectors.

Module 4: **[9L]**

A) Code generation:

Issues in the design of a code generator: Memory management; Instruction selection;
The target machine.
Run-time storage management.
Basic blocks and flow graphs: Transformations on basic blocks; Flow graphs; Loops;
A simple code generator: Algorithm; Conditional statements;
Register allocation and assignment.
The DAG representation of basic blocks. (5L)

B) Code optimization:

Principal source of optimization: common subexpression, Copy propagation, Dead – code elimination, Loop optimization, Code motion, Induction variables.
Loops in flow graphs: Dominators, Natural loops, Inner loops.
Peephole optimization. (4L)

References :

[1] Aho, Sethi, Ullman: Compilers: Principles, Techniques and Tools: 1st Edition, Pearson Education.
[2] Holub - "Compiler Design in C" – PHI
[3] Tremblay and Sorenson Compiler Writing-McgrawHill International .
[4] Chattopadhyay , S- Compiler Design (PHI)

Course Outcome:

- On completion this course, students are expected to have an overview of how a real life compiler works across various phases.
- Besides this students should be able to understand various necessary tasks related to compilers like token identification, grammar writing, type conversion and storage management.
- Also students will learn to generate intermediate codes, generate actual machine codes targeting a particular architecture and optimize generated code across various phases of the compilation process.

OPTIONS FOR ELECTIVE II

CSEN 4141 Information Retrieval
CSEN 4142 Advanced Operating System
CSEN 4143 Computational Geometry
CSEN 4144 Data Mining and Knowledge Discovery
CSEN 4145 Cloud Computing

Course Name : Information Retrieval					
Course Code: CSEN 4141					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module-1: [9L]

Introduction [2L]: Introduction to Information Retrieval, Goals and history of IR (Information Retrieval), The impact of the web on IR.

Basic IR Models [4L]: Boolean model, Vector Space Model, Probabilistic information retrieval models ; ranked retrieval; text-similarity metrics; TF-IDF (term frequency/inverse document frequency) weighting; cosine similarity.

Basic Tokenizing, Indexing and Implementation of Vector-Space Retrieval [3L]:
Simple tokenizing, stop-word removal, and stemming; inverted indices; efficient processing with sparse vectors.

Module-2: [9L]
Experimental Evaluation of IR [2L]: Performance metrics: recall, precision, and F-measure; Evaluations on benchmark text collections.
Query Operations [3L]: Relevance feedback; Query expansion; Query languages.
Text Representation [4L]: Word statistics; Heaps' law; Zipf's law; Porter stemmer; morphology; index term selection; using thesauri. Metadata and markup languages (SGML, HTML, XML).

Module-3:[9L]
Web Search [4L]: Search engines; Spidering; Metacrawlers; directed spidering; Link analysis (e.g. hubs and authorities, Google PageRank); shopping agents.
Text Categorization [5L]: Categorization algorithms: Rocchio classification, Nearest neighbor classification, and Naive Bayes classification. Applications to information filtering and organization.

Module-4:[9L]
Language-Model Based Retrieval [1L]: Language models, the query likelihood model, Language modeling versus other approaches in IR. Extended language modeling approaches.
Text Clustering [4L]: Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM). Applications to web search and information organization.
Recommender Systems[2L]: Collaborative filtering and content-based recommendation of documents and products.
Information Extraction and Integration[2L]: Extracting data from text; semantic web; collecting and integrating specialized information on the web.

<u>Course Outcomes</u>

1. Students should be able to demonstrate basic knowledge of information retrieval and relates models.
2. Students should be able to write programs to implement the related IR algorithms when necessary.
3. Students will get an exposure to the present state-of-the-art algorithms and methods in the area of information retrieval. Therefore, it will act as a primer for students, who want to pursue research in IR in future.

TEXT BOOKS:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, "Introduction to Information Retrieval", Cambridge University Press.
2. Baeza-Yates and Ribeiro-Neto, "Modern Information Retrieval", Pearson Education.
3. Bruce Croft, Donald Metzler, Trevor Strohman, "Search Engines: Information Retrieval in Practice", Pearson Education.
4. Soumen Chakrabarti,"Mining the Web: Discovering Knowledge from Hypertext Data", Morgan Kaufmann.
5. David A Grossman and Ophir Frieder, "Information Retrieval: Algorithms and Heuristics", 2nd Edition, Springer International Edition, 2004.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name: ADVANCED OPERATING SYSTEMS					
Paper Code: CSEN 4142 [39L]					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module I [Total: 9]

Introduction: [4]
Architecture of distributed OS, Global Knowledge, Naming, Scalability, Compatibility, Process Synchronization, Resource Management, Security, Communication Networks, Communication Primitives, The Message Passing model, Remote Procedure Call.

System Operating Structures: [3]
Review of structures: monolithic kernel, layered systems, virtual machines. Process based models and client server architecture; The micro-kernel based client-server approach.
Communication [2]
Inter-process communication, Remote Procedure Call, Remote Object Invocation, Tasks and Threads. Examples from LINUX, Solaris 2 and Windows NT.

Module II [Total: 8]
Theoretical Foundation of Distributed Operating Systems: [3]
Inherent Limitations of a distributed system, Lamport's Logical Clock, Casual Ordering of Messages, Chandy-Lamport's Global State Recoding System.
Distributed Mutual Exclusion: [5]
Classification of distributed mutual exclusion algorithm. NonToken based Algorithm: Lamport's, Ricart-Agrawala, and Mackawa algorithms. Token based Algorithm: Suzuki-Kasami's broadcast algorithm.

Module III [Total: 10]
Distributed Deadlock Detection: [6]
The system model, Resource vs Communication Deadlocks, Wait-for Graphs, Deadlock Handling Strategies in Distributed systems, Issues in Deadlock detection & Resolution, Control organizations for distributed deadlocks, Ho-Ramamoorthy's Centralized deadlock detection algorithm, Distributed deadlock detection algorithms, Obermark's, Chandy-Sinha-Natarajan, Chandy-Misra-Haas algorithms.
Protection and Security: [4]
Requirements for protection and security regimes. The access matrix model of protection. System and user modes, rings of protection, access lists, capabilities. User authentication, passwords and signatures. Use of single key and public key encryption.

Module IV [Total: 12]
Distributed File System: [4]
Architecture, Mounting, Caching, Naming and Name Resolution, Name Server, Cache Consistency, SUN Network File System, Stateful and Stateless Server, the SPRITE File System, the X-Kernel Logical File System.
Multiprocessor Operating Systems: [5]
Difference between Multiprocessing and Distributed environments, Tightly coupled vs Loosely Coupled systems, UMA, NUMA, NORMA architectures, Interconnection networks for multiprocessor systems, BUS, Crossbar Switch, Multistage, Hypercube architectures, the separate supervisor, master slave, symmetric configuration, Threads, User-level and Kernel Level threads, Case Studies (MACH OS, MACH Kernel).
Real Time Operating System: [3]
Definition, types of RTOS, A reference model of Real Time System, Commonly used approaches to Real Time Scheduling.

Module-II:

Point Location and Triangulation [5L]

Planar Point Location, Triangulation of Arbitrary Polygon, Kirkpatrick's method, trapezoidal decompositions and analysis, history DAGs

Voronoi Diagram and Delaunay Triangulation [4L]

Closest Pairs. Bichromatic Closest Pairs, Fortune's sweep Algorithm, Delaunay triangulations

Module-III:

Range Searching [7L]

Introduction, Orthogonal Range searching, Priority Search Trees (kd-trees, range trees, segment trees), Non - Orthogonal Range Searching, Half - Plane Range Query, Adding range restrictions. Colored Range Searching.

Module-IV:

Arrangements and Duality [4L]

Point/line duality, incremental construction of arrangements and the zone-theorem, applications.

Geometric Approximation [3L]

Dudley's theorem and applications, well-separated pair decompositions and geometric spanners, VC dimension, epsilon-nets and epsilon-approximations

Textbooks:

1. **Computational Geometry: Algorithms and Applications** (2nd Edition), M. de Berg, M. van Kreveld, M. Overmars, O. Schwarzkopf, Springer-Verlag, 2000.
2. **Computational Geometry**, F. Preparata and M. Shamos, Springer-Verlag, 1985

References:

1. **Computational Geometry: An Introduction Trough Randomized Algorithms,** K. Mulmuley, , Prentice-Hall, 1994
2. **Discrete and Computational Geometry,** S. L. Devadoss and J. O'Rourke, 2011
3. **Computational Geometry Lecture Notes,** David M. Mount, Department of Computer Science, University of Maryland, Fall 2002

Subject Name: DATA MINING & KNOWLEDGE DISCOVERY					
Paper Code: CSEN4144					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module I. Introduction and Rule-based Classification **[9L]**

What is Data Mining? Why do we need data mining? Differences between Data Mining and Machine Learning. Motivating challenges in Data Mining. **(2L)**

Decision Tree (5L): General approach for solving a classification problem. Decision Tree Induction – How a decision tree works, how to build a decision tree, expressing attribute test conditions, measures for selecting best split, algorithm for decision tree induction. Model overfitting – Pre-pruning, post-pruning.

Rule-based Classification (2L):

How a rule-based classifier works, rule-ordering schemes, how to build a rule-based classifier, direct and indirect methods for rule extraction.

Module II. Advanced Classification Techniques [9L]
Bayesian Classifier (3L): Bayes theorem – using it for classification, Naïve Bayes classifier, Bayes error rate.
Support Vector Machines (SVM) (6L):
Maximum margin hyperplanes, Linear SVM: separable case, non-separable case, Non-linear SVM.
Module III. Ensemble Methods, Association Rule Mining [9L]
Ensemble Methods (3L): Bagging, Boosting, Random Forests
Association Rule Mining (6L):
Problem definition, Frequent itemset generation (Apriori principle, candidate generation and pruning), Rule generation, Compact representation of frequent itemsets, FP-growth algorithm, Sub-graph mining.
Module IV. Cluster Analysis [9L]
What is clustering analysis? Motivations, objectives and applications of clustering. Different types of clustering. (1L)
Partitional Clustering (2L): K-means, Bisecting K-means, PAM.
Hierarchical Clustering (3L): Agglomerative, Divisive, MIN, MAX, dendrogram representation.
Density-based Clustering (2L): DBSCAN.
Cluster evaluation, further reading – OPTICS, DENCLUE, CHAMELEON, BIRCH, CURE, ROCK **(1L).**

Text Books :
1. Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach and Vipin Kumar. Pearson Publishers.
2. Machine Learning by Tom Mitchell.

Reference
1. Data Mining: Concepts and Techniques by Jiawei Han and Micheline Kamber. Publisher: Elsevier.

Course Outcomes:
1. Students should be able to demonstrate basic knowledge of data mining and related models.
2. Students should be able to write programs to implement the related data mining algorithms when necessary.
3. Students will get an exposure to the present state-of-the-art algorithms and methods in the area of data mining. This expertise will help them in pursuing research in areas related to data mining.

Subject Name: CLOUD COMPUTING					
Paper Code: CSEN 4145					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Educational Objectives:
The main objective of the course is to focus on learning emerging issues related to cloud computing.
1. To gain familiarity with basic concepts related to cloud computing models – NIST, Cloud Cube
2. To understand the architecture and concepts of cloud service models – IaaS, PaaS, SaaS
3. To become familiar with application development and deployment cloud platforms – from Amazon [e.g., Elastic Compute Cloud (EC2), Amazon Web Services (AWS)], from Google [e.g., Google App Engine (GAE), Google Web Toolkit (GWT)]
4. To learn basic features of distributed file systems such as Hadoop Distributed File System (HDFS) and Google File System (GFS)
5. To gain exposure to the underlying principles of cloud virtualization, cloud storage, cloud security

Module II. Advanced Classification Techniques [9L]
Bayesian Classifier (3L): Bayes theorem – using it for classification, Naïve Bayes classifier, Bayes error rate.
Support Vector Machines (SVM) (6L):
Maximum margin hyperplanes, Linear SVM: separable case, non-separable case, Non-linear SVM.
Module III. Ensemble Methods, Association Rule Mining [9L]
Ensemble Methods (3L): Bagging, Boosting, Random Forests
Association Rule Mining (6L):
Problem definition, Frequent itemset generation (Apriori principle, candidate generation and pruning), Rule generation, Compact representation of frequent itemsets, FP-growth algorithm, Sub-graph mining.
Module IV. Cluster Analysis [9L]
What is clustering analysis? Motivations, objectives and applications of clustering. Different types of clustering. (1L)
Partitional Clustering (2L): K-means, Bisecting K-means, PAM.
Hierarchical Clustering (3L): Agglomerative, Divisive, MIN, MAX, dendrogram representation.
Density-based Clustering (2L): DBSCAN.
Cluster evaluation, further reading – OPTICS, DENCLUE, CHAMELEON, BIRCH, CURE, ROCK **(1L).**

Text Books :
1. Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach and Vipin Kumar. Pearson Publishers.
2. Machine Learning by Tom Mitchell.

Reference
1. Data Mining: Concepts and Techniques by Jiawei Han and Micheline Kamber. Publisher: Elsevier.

Course Outcomes:
1. Students should be able to demonstrate basic knowledge of data mining and related models.
2. Students should be able to write programs to implement the related data mining algorithms when necessary.
3. Students will get an exposure to the present state-of-the-art algorithms and methods in the area of data mining. This expertise will help them in pursuing research in areas related to data mining.

Subject Name: CLOUD COMPUTING					
Paper Code: CSEN 4145					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Educational Objectives:
The main objective of the course is to focus on learning emerging issues related to cloud computing.
1. To gain familiarity with basic concepts related to cloud computing models – NIST, Cloud Cube
2. To understand the architecture and concepts of cloud service models – IaaS, PaaS, SaaS
3. To become familiar with application development and deployment cloud platforms – from Amazon [e.g., Elastic Compute Cloud (EC2), Amazon Web Services (AWS)], from Google [e.g., Google App Engine (GAE), Google Web Toolkit (GWT)]
4. To learn basic features of distributed file systems such as Hadoop Distributed File System (HDFS) and Google File System (GFS)
5. To gain exposure to the underlying principles of cloud virtualization, cloud storage, cloud security

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Outcomes:

At the end of the course the students will be able to:

1. Appreciate the benefits and limitations of cloud based computing environments
2. Understand the underlying principles of cloud virtualization, cloud storage, cloud security
3. Analyze the suitability and/or applicability of various cloud computing models, platforms, services, solution offerings and tools from some industry leaders
4. Gain insight into various distributed computing issues (like performance, scalability, availability, reliability) in light of distributed file systems (such as HDFS, GFS)
5. Identify security and privacy issues in cloud computing

Detailed Syllabus:

1) Module-1: Basics of Cloud Computing: [06L]
   - i) Defining a Cloud
   - ii) Cloud Types – NIST Cloud Reference Model, Cloud Cube Model
   - iii) Deployment Models – Public, Private, Hybrid, and Community Clouds
   - iv) Service Models – Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)
   - v) Characteristics of Cloud Computing
   - vi) Benefits and Limitations of Cloud Computing

2) Module-2: Cloud Services and/or Applications: [10L]
   - i) IaaS – Basic Concept and Characteristics, Virtual Machine Instances / Images, examples of IaaS solutions
   - ii) PaaS – Basic Concept and Characteristics, Tools and Development Environment with examples
   - iii) SaaS – Basic Concept and Characteristics, Open SaaS and SOA, examples of SaaS solutions
   - iv) Identity as a Service (IDaaS)

3) Module-3: Cloud Solution Offerings: [11L]
   - a) Concepts of Abstraction and Virtualization: [03L]
     - i) Virtualization: Taxonomy of Virtualization Techniques
     - ii) Hypervisors: Machine Reference Model for Virtualization
   - b) Solution Offerings from Industry Leaders: [08L]
     - i) Amazon: some AWS Components and Services – Compute (EC2), Storage [Simple Storage Service (S3), Elastic Block Store (EBS), Simple Queue Service (SQS)], Database (Relational, NoSQL, SimpleDB), Content Distribution (CloudFront), Deployment (Elastic Beanstalk)
     - ii) Google: quick look at Google Applications Portfolio – AdWords, Analytics, overview of GWT, a few Google APIs, some key services of GAE

4) Module-4: Cloud Storage and Security: [09L]
   - a) Cloud-based Storage: [06L]
     - i) Block Devices and File Devices
     - ii) Managed Storage and Unmanaged Storage
     - iii) File Systems – GFS and HDFS
   - b) Cloud Security: [03L]
     - i) Security Concerns, Security Boundary, Security Service Boundary
     - ii) Security Mapping Overview
     - iii) Data Security – Storage Access, Storage Location, Tenancy, Encryption, Auditing, Compliance
     - iv) Identity Management (awareness of Identity Protocol Standards)

Books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2012
2. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited, 2013
3. Cloud Computing: Theory and Practice by Dan Marinescu, Morgan Kaufmann, 2014

4. Cloud Computing: A Hands-on Approach by A Bahga and V Madisetti, 2014
5. Cloud Computing: A Practical Approach for Learning and Implementation by A Srinivasan and J Suresh, Pearson, 2014
6. Cloud Computing by U S Pande and Kavita Choudhary, S Chand, 2014
7. Cloud Computing for Dummies by J Hurwitz, M Kaufman, F Halper, R Bloor, John Wiley & Sons, 2014
8. Cloud Computing by Kris Jamsa, Jones & Bartlett Learning, 2015

Papers:

1. The NIST Definition of Cloud Computing: Recommendations of the National Institute of Standards and Technology by Peter Mell and Timothy Grance, National Institute of Standards and Technology Special Publication 800-145, ©2011
2. Introduction to Cloud Computing Architecture: White Paper (1st Edition) by Sun Microsystems Inc., ©2009
3. A Survey on Open-source Cloud Computing Solutions by Patrícia Takako Endo, Glauco Estácio Gonçalves, Judith Kelner, Djamel Sadok, VIII Workshop on Clouds, Grids and Applications at UFPE, Brazil
4. GFS: Evolution on Fast-Forward – Kirk McKusick (BSD/BFFs) interviews Sean Quinlan (former GFS Tech Leader), CACM, ©2009-2010
5. The Google File System (GFS) by Sanjay Ghemawat, Howard Gobioff, Shun-Tak Leung, ©2011
6. The Hadoop Distributed File System: Architecture and Design by Dhruba Borthakur, Apache Software Foundation, ©2007.

OPTIONS FOR ELECTIVE III

CSEN 4161 Natural Language Processing
CSEN 4162 Cryptography and Network Security
CSEN 4163 Graph Algorithms
CSEN 4164 Parallel Algorithms
CSEN 4165 Web Intelligence and Big Data

Subject Name: Natural Language Processing					
Paper Code: CSEN 4161					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

1. Understanding the models, methods, and algorithms of statistical Natural Language Processing (NLP) for common NLP tasks and in future do speech recognition, machine translation, spam filtering, text classification, and spell checking.
2. Students can understand the probabilistic models, estimate parameters for such models.
3. The student may apply core computer science concepts and algorithms, such as dynamic programming.
4. The student can gain understanding of linguistic phenomena and will explore the linguistic features relevant to each NLP task.
5. The student can see opportunities for research await and prepare to conduct research in NLP or related fields.

Module I:
Introduction to NLP [2L]:
Natural language processing: issues and strategies. Tools for NLP, Linguistic organization of NLP. NLP as an Application domain. 2L

Word Classes [7L]:

Regular Expressions: Chomsky hierarchy, CFG and different parsing techniques 2L

Morphology: Inflectional, derivational, parsing and parsing with FST, Combinational Rules 2L

Introduction to probability theory: The backbone of modern NLP, Joint and conditional probability, marginal, independence. Probabilistic Language modeling and it's Applications. 3L

Module II:

Language Modeling and Naïve Bayes [4L]:

Markov models, N- grams. Estimating the probability of a word and smoothing. Counting words in Corpora, simple N-grams, smoothing (Add One, Written-Bell, Good-Turing),4L

Part Of Speech Tagging and Hidden Markov Models [7L]: Part of Speech tagging, The Penn Treebank and Brown Corpus. Noun –phrase segmentation and information extraction models that combine maximum entropy and finite –state machines. HMM tagger, rule based and stochastic POST, Viterbi algorithm for finding most likely HMM Path. HMM tagging, transformation based tagging. 4L

Probabilistic Context Free Grammars: Weighted context free grammars .Weighted CYK. Pruning and beam search. 3L

Module III:

Semantics [9 L]:

Representing Meaning: Unambiguous representation, canonical form, expressiveness, meaning structure of language, 2L

Semantic Analysis: Syntax driven, attachment & integration, robustness 2L

Lexical Semantics: Lexemes (homonymy, polysemy, synonymy, hyponymy), WordNet, internal structure of words, metaphor and metonymy and their computational Approaches 3L

Word Sense Disambiguation: Selectional restriction based, machine learning based and dictionary based approaches. 2L

Module IV:

Pragmatics [10L]:

Information Theory: Entropy, Cross-entropy, information gain. 2L

Discourse: Reference resolution and phenomena, syntactic and semantic constraints. Pronoun resolution algorithm, text coherence, and discourse structure 4L

Dialogues: Turns and utterances, grounding, dialogue acts and structures 1L

Natural Language Generation: Introduction to language generation, architecture, discourse planning (text schemata, rhetorical relations). 3L

Text Book:

1. D. Jurafsky & J. H. Martin – "Speech and Language Processing – An introduction to Language processing,
2. Computational Linguistics, and Speech Recognition", Pearson Education

Reference Books:

1. Allen, James. 1995. – "Natural Language Understanding". Benjamin/Cummings, 2ed.
2. Bharathi, A., Vineet Chaitanya and Rajeev Sangal. 1995. Natural Language Processing- "A Pananian Perspective". Prentice Hll India, Eastern Economy Edition.
3. Eugene Cherniak: "Statistical Language Learning", MIT Press, 1993.
4. Manning, Christopher and Heinrich Schutze. 1999. "Foundations of Statistical Natural Language Processing". MIT Press.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Cryptography and Network Security					
Paper Code: CSEN 4162					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Expected Course Outcome:-

CO1: To discuss on various types of attacks and their characteristics.

CO2: To illustrate the basic concept of encryption and decryption for secure data transmission.

CO3: To Analyze and compare various cryptography techniques.

CO4: To explain the concept of digital signature and its applications.

CO5: To be familiar with network security designs using available secure solutions (such as PGP, SSL, IPSec, etc)

Module 1. Introduction and Number Theory

Introduction- Need for Security, Security approaches, Principles of Security, Types of attack, Plain text & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Symmetric & Asymmetric key Cryptography, Key Range & Key Size. [4L]

Brief introduction to number theory, Euclidean algorithm, Euler's totient function, Fermat's theorem and Euler's generalization, Chinese Remainder Theorem, primitive roots and discrete logarithms, Quadratic residues, Legendre and Jacobi symbols. [8L]

Module 2. Symmetric Key and Asymmetric Key Cryptography

Symmetric Key Cryptography- Overview, Block Cipher, DES algorithm, AES algorithm, IDEA algorithm, Blowfish, RC5 algorithm. [8L]

Asymmetric Key Cryptography – Overview, RSA, Key Management – Key Distribution, Diffie-Hellman Key Exchange Algorithm, Elliptic Curve Arithmetic, Elliptic Curve Cryptography [4L]

Module 3. Authentication

Authentication Methods – Message Digest, Kerberos [6L]

Digital Signatures – Algorithms (DSA, ElGamal signature, ECDSA), Digital Signature Standard, Authentication Protocols [6L]

Module 4. Internet Security

Email Security – PGP, MIME, S/MIME. [3L]

IP Sec-Architecture, AH protocol, Encapsulating Security Payload (ESP) Protocol, ISAKMP Protocol, Oakley Key Determination Protocol, VPN [6L]

Web Security-SSL, Firewalls [3L]

References

1. Cryptography and Network Security: Principles and Practice, 7/E, William Stallings, Pearson.
2. Cryptography and Network Security, 3rd Edition, Atul Kahate, McGraw Hill Education (India) Private Limited.
3. Cryptography and Information Security, 2nd Edition, V. K. Pachghare, PHI Learning Private Limited.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Course Name : Graph Algorithms					
Course Code: CSEN 4163					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Learning Objective: The main objective of the course is for students to learn some classical theorems and algorithms in this domain. It is expected that students will be able to demonstrate their knowledge of algorithms by solving concrete problems. In addition, students will learn some proofs of the discussed theorems and prove simple facts about graphs and graph algorithms.

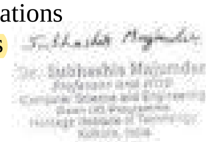
Course Outcomes:
Students who complete the course will demonstrate the ability to do the following:
1. Learn the advanced concepts and key features of Graph algorithms.
2. Understand the algorithmic approach to Graph related problems.
3. Explain and analyze the major graph algorithms.
4. Employ graphs to model engineering problems, when appropriate.
5. Defend and argue the application of the specific algorithm to solve a given problem.
6. Synthesize new algorithms that employ graph computations as key components, and analyze them.
7. Hypothesize for a critical problem, where graph is involved as an absolutely necessary component.

Module I: [7L]
Connected components and transportation related graph problems
i) Representation of graphs
ii) Strongly connected components, Tarjan's algorithm for strongly connected components
iii) Eulerian tours, Hamiltonian cycles and Travelling salesman problem.
iv) Exponential-time dynamic programming for the TSP, approximation algorithms and the approximation ratio, MST-doubling heuristic, Christofides' heuristic.

Module II: [9L]
Matching and covering related graph problems
i) Matchings, stable marriage problem, Gale-Shapley algorithm for stable marriage problem.
ii) Bipartite graphs, formulating bipartite maximum matching as a flow problem,
iii) Hopcroft–Karp algorithm. Using matchings to find vertex covers and independent sets.

Module III: [9L]
Graph Coloring, Max cut, Min cut, Clique problems, longest path
i) Graph coloring, greedy coloring, Maximal clique, interval graphs, perfect graphs, chordal graphs.
ii) Maximum Clique-Minimum coloring problem. (in interval graph)
iii) Introduction to planarity of the graph, duality of the planar graph and max cut of the planar graph.
iv) Algorithms for independent set, clique and vertex coloring in chordal graphs
v) Longest path Problem, hardness and heuristic for solution

Module IV: [7L]
Flow networks and random graphs
i) Max flow min cut theorem, max flow algorithms and their applications
ii) Min cost max flow algorithm, their applications
iii) Random graphs and probabilistic methods



Text Books
1. Introduction to Graph Theory, Douglas B. west, Prentice Hall, 2001.
2. Graph Theory and Its Applications Jonathan L. Gross and Jay Yellen
3. Algorithm Design - Jon Kleinberg and Eva Tardos

4. Advanced graph algorithms, T.kloks

Reference Books

1. R. Diestel, "Graph Theory", Springer-Verlag, 2nd edition, 2000
2. Bela Bollobas, Modern Graph Theory, Springer, 1998

Code	Subject	Contact periods / week			Total	Credits
		L	T	P		
CSEN4164	Parallel Algorithms	3	0	0	3	3

Module 1:
Introduction: **[10L]**
A) Architecture: Parallelism in uniprocessor system, memory-interleaving, pipelining and vector processing, parallel computer structures, architectural classifications; Shared-Memory (SM) SIMD Computers – EREW / CREW / ERCW/ CRCW; Programming MIMD Computers; (4L)
B) System interconnect architectures: Static interconnection networks: array, tree, mesh, hypercube, cube-connected-cycles, butterfly, Cayley graphs; Dynamic interconnection networks: crossbar, Clos network, multistage interconnection networks, blocking, non-blocking and rearrangeable operations, properties and routing. (3L)
C) Parallel computer models*:* PRAM models, program properties: conditions of parallelism, program partitioning and scheduling, granularity and scalability. (2L)
D) Analyzing Algorithms: Running Time, Speedup, Number of Processors. (1L)

Module 2: Basic Algorithms: **[10L]**
A) Selection: A sequential algorithm; Desirable Properties for Parallel Algorithms: Number of Processors, Running Time, Cost. An Algorithm for Parallel Selection. (2L)
B) Basic Techniques: Balanced Trees; Divide & Conquer; Partitioning; Pipelining; Cascading; (2L)
C) Merging: A Network for Merging; Merging on the CREW & EREW Model ; Finding the Median of Two Sorted Sequences; (2L)
C) Sorting: Sorting on a Linear Array, Sorting on the CRCW /CREW / EREW model; Sorting by Conflict-Free Merging, Sorting by Selection. (2L)
D) Searching: Searching on a sorted sequence / random sequence / Trees / Mesh. (2L)

Module 3: General Data Structures: **[8L]**
A) Lists & Trees*:* List ranking; Euler-Tour technique; Tree contraction; (3L)
B) Graphs: Connected components; Minimum Spanning Trees; All pairs shortest paths; (3L)
C) Strings: String Matching; Text Analysis; (2L)

Module 4: **[12L]**
A) Arithmetic Computation*:* Adding n integers; Multiplying two numbers; Prefix sum; Polynomial Multiplication & Division; (3L)
B) Matrix Operations*:* Transposition; Matrix multiplication; (2L)
C) Decision and Optimization problem: Computing Prefix Sums; Knapsack problem; (2L)
D) Fourier Transforms: Fast Fourier Transform; The DFT computation in parallel; (2L)
E) Networked computers as a multi-computer platform: Basics of message passing, computing using workstation clusters, software tools, Message Passing Interface MPI, CUDA and General Purpose GPU (GPGPU) programming. (3L)

References :

1. S.G.Akl: Design and Analysis of Parallel Algorithms, Prentice Hall.
2. J. Ja Ja: Introduction to Parallel Algorithms, Addison Wesley, 1990.
3. M.G. Quinn: Design of Efficient Algorithms for Parallel Computers, McGraw Hill, 1988.
4. K. Hwang: Computer Arithmetic: Principles, Architecture and Design, John Wiley.
5. Hwang & Briggs: Advanced Computer Architecture and Parallel processing, McGraw Hill.
6. Peter Pacheco: Parallel Programming with MPI
7. Jason Sanders, Edward Kandrot: CUDA by Example: An Introduction to General-Purpose GPU Programming.
8. T. Leighton: Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes, Morgan Kauffmann Pub., San Mateo, 1992.

Course Outcomes/Learning Objectives:

1. On completion this course, students are expected to be able to understand the special techniques required for designing and analyzing parallel algorithms
2. Besides this students should be able to understand the process of how a sequential version of an algorithm can be converted to a parallel version and how the performance improvements can be compared with respect to the predicted analysis.
3. Also students will pick up rudimentary skills of some parallel programming techniques and use the same for implementing and testing some of the parallel algorithms learnt in this course.

Subject Name: WEB INTELLIGENCE AND BIG DATA					
Paper Code: CSEN4165					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module 1: Intelligent Information Retrieval

Learning from user interactions. Rating and voting, emailing and link forwarding, bookmarking, purchasing items, reviews.

Extracting intelligence from tags. Tag related metadata. Tag generation. Leveraging tags: dynamic navigation, using tag clouds, targeted search, recommendations based on tags.

Extracting intelligence from content: Blogs, Wikis, Message boards.

Module 2: Clustering, Classification and Recommendations

Clustering and web intelligence. Overview of clustering algorithms.

Classification and Web Intelligence. Need for classification. Overview. Automatic categorization of emails and spam filtering. Classification and fraud detection. Combining classifiers.

Creating Suggestions and Recommendations. Concepts of distance and similarity. Recommendations based on similar users. Recommendations based on similar items. Recommendations based on content.

Module 3: Introduction to Hadoop

Starting Hadoop. Components of Hadoop. HDFS. Working with files in HDFS. Introduction to MapReduce. Streaming in Hadoop. Advanced MapReduce: Chaining MapReduce jobs, Joining data from different sources. Developing MapReduce programs in local mode and pseudo-distributed mode. Moving data into and out of Hadoop. Data input and output in MapReduce. Applying MapReduce patterns to Big Data. Streamlining HDFS for big data.

References :

1. S.G.Akl: Design and Analysis of Parallel Algorithms, Prentice Hall.
2. J. Ja Ja: Introduction to Parallel Algorithms, Addison Wesley, 1990.
3. M.G. Quinn: Design of Efficient Algorithms for Parallel Computers, McGraw Hill, 1988.
4. K. Hwang: Computer Arithmetic: Principles, Architecture and Design, John Wiley.
5. Hwang & Briggs: Advanced Computer Architecture and Parallel processing, McGraw Hill.
6. Peter Pacheco: Parallel Programming with MPI
7. Jason Sanders, Edward Kandrot: CUDA by Example: An Introduction to General-Purpose GPU Programming.
8. T. Leighton: Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes, Morgan Kauffmann Pub., San Mateo, 1992.

Course Outcomes/Learning Objectives:

1. On completion this course, students are expected to be able to understand the special techniques required for designing and analyzing parallel algorithms
2. Besides this students should be able to understand the process of how a sequential version of an algorithm can be converted to a parallel version and how the performance improvements can be compared with respect to the predicted analysis.
3. Also students will pick up rudimentary skills of some parallel programming techniques and use the same for implementing and testing some of the parallel algorithms learnt in this course.

Subject Name: WEB INTELLIGENCE AND BIG DATA					
Paper Code: CSEN4165					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module 1: Intelligent Information Retrieval

Learning from user interactions. Rating and voting, emailing and link forwarding, bookmarking, purchasing items, reviews.

Extracting intelligence from tags. Tag related metadata. Tag generation. Leveraging tags: dynamic navigation, using tag clouds, targeted search, recommendations based on tags.

Extracting intelligence from content: Blogs, Wikis, Message boards.

Module 2: Clustering, Classification and Recommendations

Clustering and web intelligence. Overview of clustering algorithms.

Classification and Web Intelligence. Need for classification. Overview. Automatic categorization of emails and spam filtering. Classification and fraud detection. Combining classifiers.

Creating Suggestions and Recommendations. Concepts of distance and similarity. Recommendations based on similar users. Recommendations based on similar items. Recommendations based on content.

Module 3: Introduction to Hadoop

Starting Hadoop. Components of Hadoop. HDFS. Working with files in HDFS. Introduction to MapReduce. Streaming in Hadoop. Advanced MapReduce: Chaining MapReduce jobs, Joining data from different sources. Developing MapReduce programs in local mode and pseudo-distributed mode. Moving data into and out of Hadoop. Data input and output in MapReduce. Applying MapReduce patterns to Big Data. Streamlining HDFS for big data.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Module 4: Algorithms Using MapReduce

Matrix-Vector Multiplication by MapReduce. Relational-Algebra Operations. Computing Selections by MapReduce. Computing Projections by MapReduce. Union, Intersection, and Difference by MapReduce. Computing Natural Join by MapReduce. Grouping and Aggregation by MapReduce. Matrix Multiplication.

Graph Algorithms using MapReduce: Shortest Paths, Friends-of-Friends. PageRank computation in MapReduce.

Course Outcome

1. Web Intelligence is a fast-growing area of research that combines multiple disciplines including artificial intelligence, machine learning, data mining, natural language processing.
2. Making the web intelligent is the art of customizing items in response to the needs of the users. Predicting users‘behaviors will expedite and enhance browsing experience, which could be achieved through personalization.
3. The first half of this subject will provide the students a platform which will give them an introduction to the subject and will empower them to find the most appropriate and best information for their interest.
4. Hadoop and MapReduce are useful tools to work with Big Data. Hadoop is a free, Java-based programming framework that supports the processing of large data sets in a distributed computing environment. MapReduce is a core component of the Apache Hadoop software framework.
5. The second half of the course gives students an introduction to the use of Hadoop and MapReduce.

Text Books:

1. Algorithms of the Intelligent Web. H. Marmanis and D. Babenko. Manning Publishers, 2009.
2. Collective Intelligence in Action. S. Alag. Manning Publishers, 2009.
3. Hadoop in Action by Chuck Lam. Manning Publishers. 2011.
4. Hadoop in Practice by Alex Holmes. Manning Publishers. 2012.
5. Mining of Massive Datasets by Jure Leskovec, Anand Rajaraman, Jeff Ullman. Cambridge University Press. 2011.

Reference Books:

1. Mining the Web: Discovering Knowledge from Hypertext Data.
2. S. Chakrabarti, Morgan-Kaufmann Publishers, 2002.
3. Recommender Systems Handbook: Francesco Ricci, Lior Rokach, Bracha Shapira, Paul B. Kantor, Springer, 2011.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

OPTIONS FOR ELECTIVE IV

CSEN 4241 Distributed Algorithms
CSEN 4242 Approximation Algorithms
CSEN 4243 Computational Complexity
CSEN4244 Pattern Recognition
CSEN4245 Social Network Analysis
CSEN 4246 Mobile Computing

Course Name : Distributed Algorithms					
Course Code: CSEN 4241					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

1. The student will **learn the basics** of distributed algorithms, which are designed to run on multiple processors, without tight centralized control
2. The student will understand various kinds of distributed computing environments, including shared-memory and network-based environments
3. The student will be able to **identify** problems solvable in distributed computing environments and will also be able to identify certain tasks which cannot be carried out in certain kinds of distributed settings
4. They will be able to **design** distributed algorithms and **analyze** the correctness, performance, and fault-tolerance of their algorithms. They will also learn to prove lower bounds and other impossibility results in distributed settings.
5. The students learn the **applications** in many practical systems, ranging from large computer networks to multiprocessor shared-memory systems, including problems of communication, data management, resource management, synchronization, and distributed agreement.

Course Details:

Module I: [8L]

Synchronous networks: – Model – Leader election (symmetry-breaking) – Network searching, Broadcast and converge-cast. Shortest paths, spanning trees – Processor failures: Stopping and Byzantine – Fault-tolerant consensus: Algorithms and lower bounds – Other problems: Commit, k-agreement, Approximate agreement. Distributed commit

Module II: [8L]

Asynchronous model – Interaction State Machines (I/O automata), Proving Correctness of Distributed algorithms•. Asynchronous networks, no failures: – Model – Leader election, network searching, spanning trees, revisited. – Synchronizers (used to run synchronous algorithms in asynchronous networks) – Logical time, replicated state machines. – Stable property detection (termination, deadlock, snapshots).

Module III: [12L]

Asynchronous shared-memory systems, no failures: – Model – Mutual exclusion algorithms and lower bounds – Practical mutual exclusion algorithms – Resource allocation, Dining Philosophers • Asynchronous shared-memory, with failures – Impossibility of consensus – Atomic (linearizable) objects, atomic read/write objects, atomic snapshots – Wait-free computability; wait-free consensus; wait-free vs. f-fault-tolerant objects

Module IV: [12L]

Shared-memory multiprocessor programming – Contention, caching, locality – Reader/writer locks – List algorithms: locking algorithms, optimistic algorithms, lock-free algorithms – Transactional memory Asynchronous networks, with failures – Asynchronous networks vs. asynchronous shared-memory – Impossibility of consensus, revisited – Failure detectors and consensus – Paxos consensus algorithm • Self-stabilizing algorithms • Partially-synchronous systems – Models – Timing-based Mutual exclusion, consensus – Clock synchronization

Text Book:
1. Title: **Distributed Algorithms, (The Morgan Kaufmann Series in Data Management Systems).**
Author: **Nancy A. Lynch**

References:
1. Title: **Introduction to Reliable and Secure Distributed Programming**
Author: Christian Cachin, Rachid Guerraoui, Luís Rodrigues
2. Title: **Distributed Algorithms - An Intuitive Approach**
Author: Wan Fokkink
3. Title: **Introduction to Distributed Algorithms**
Author: Gerard Tel

<table>
<tr><td colspan="6">Course Name : Approximation Algorithms</td></tr>
<tr><td colspan="6">Course Code: CSEN 4242</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
</table>

Learning Objective: The field of approximation algorithms has developed in response to the difficulty in giving exact solutions for many optimization problems. For computationally hard problems, approximation algorithms provide nearly-optimal (approximate) solutions with provable guarantees on the performance of these algorithms. A student doing this course will have an idea about the common existing techniques by which approximation algorithms are designed. Also given such situations where they have to implement a solution for such or similar problems as a part of a research project or an implementation project in the industry, they should be able to code them up. They should also develop a limited capability of designing an approximation algorithm for a new problem, which is shown to be NP-hard.

Module I: [7L]
Introduction, P vs NP, NP Optimization problems, Approximation Ratio, Additive vs. Multiplicative.
Techniques: Greedy and combinatorial methods, Local search
Module II: [7L]
Techniques: Dynamic programming and approximation schemes,
Module III: [10L]
Linear programming rounding methods (randomized, primal-dual, dual-fitting, iterated rounding), Semi-definite program based rounding
Module IV: [8L]
Metric methods, inapproximability, Hardness of approximation: simple proofs, approximation preserving reductions, some known results
Problems that can be discussed -

- Tour Problem: TSP
- Scheduling
- Connectivity & Network Design: Steiner tree, Steiner forests, Survival network
- Covering Problems: Vertex cover, Set cover.
- Constraint Satisfaction: MaxSAT problem
- Cut Problems: Sparsest cut, Multi cut, Multiway cut

Text Books
1. The Design of Approximation Algorithms, David P. Williamson and David B. Shmoys, Cambridge University Press, 2011

Reference Books
2. Approximation Algorithms by Vijay Vazirani, Springer-Verlag, 2004.

stabilizing algorithms • Partially-synchronous systems – Models – Timing-based Mutual exclusion, consensus – Clock synchronization

Text Book:
1. Title: **Distributed Algorithms, (The Morgan Kaufmann Series in Data Management Systems).**
Author: **Nancy A. Lynch**

References:
1. Title: **Introduction to Reliable and Secure Distributed Programming**
Author: Christian Cachin, Rachid Guerraoui, Luís Rodrigues
2. Title: **Distributed Algorithms - An Intuitive Approach**
Author: Wan Fokkink
3. Title: **Introduction to Distributed Algorithms**
Author: Gerard Tel

Course Name : Approximation Algorithms					
Course Code: CSEN 4242					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Learning Objective: The field of approximation algorithms has developed in response to the difficulty in giving exact solutions for many optimization problems. For computationally hard problems, approximation algorithms provide nearly-optimal (approximate) solutions with provable guarantees on the performance of these algorithms. A student doing this course will have an idea about the common existing techniques by which approximation algorithms are designed. Also given such situations where they have to implement a solution for such or similar problems as a part of a research project or an implementation project in the industry, they should be able to code them up. They should also develop a limited capability of designing an approximation algorithm for a new problem, which is shown to be NP-hard.

Module I: [7L]
Introduction, P vs NP, NP Optimization problems, Approximation Ratio, Additive vs. Multiplicative.
Techniques: Greedy and combinatorial methods, Local search
Module II: [7L]
Techniques: Dynamic programming and approximation schemes,
Module III: [10L]
Linear programming rounding methods (randomized, primal-dual, dual-fitting, iterated rounding), Semi-definite program based rounding
Module IV: [8L]
Metric methods, inapproximability, Hardness of approximation: simple proofs, approximation preserving reductions, some known results
Problems that can be discussed -

- Tour Problem: TSP
- Scheduling
- Connectivity & Network Design: Steiner tree, Steiner forests, Survival network
- Covering Problems: Vertex cover, Set cover.
- Constraint Satisfaction: MaxSAT problem
- Cut Problems: Sparsest cut, Multi cut, Multiway cut

Text Books
1. The Design of Approximation Algorithms, David P. Williamson and David B. Shmoys, Cambridge University Press, 2011

Reference Books
2. Approximation Algorithms by Vijay Vazirani, Springer-Verlag, 2004.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Pattern Recognition					
Paper Code: CSEN4244					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

Students will be able to:

1. Understand the feature, pattern and the problem of pattern recognition.
2. Describe and explain the difference between supervised and unsupervised learning.
3. Describe and explain pattern recognition algorithm that utilizes supervised learning.
4. Describe and explain pattern recognition algorithm that utilizes unsupervised learning.
5. Design simple pattern recognition systems.

Module – I: Introduction – Definitions, Representations of Patterns and Classes, overview of different approaches, Metric and non-metric measures. Feature selection criteria and algorithms; Minimum distance classifiers, k-NN rule, Discriminant functions (linear and non-linear), parametric and nonparametric learning. (9L)

Module – II: Decision Trees, Bayesian classification, Decision Boundaries, training and test sets, Neural network models for pattern recognition - Perceptron, Multi-layer Perceptron, some applications. (9L)

Module – III: Clustering techniques – Unsupervised learning, basic hierarchical and non-hierarchical clustering algorithms, c-means, fuzzy c-means, DBSCAN, Concepts of hierarchical clustering, Clustering Large datasets. (10L)

Module – IV: dimensionality reduction, principal components analysis, some applications, Some advanced topics with applications, (e.g., neuro-fuzzy approach, genetic algorithms, data mining). (10L)

REFERENCES

1. Devi V.S.; Murty, M.N., Pattern Recognition: An Introduction, Universities Press, Hyderabad, 2011.
2. R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification and Scene Analysis, 2nd ed., Wiley, New York, 2000.
3. 2. J. T. Tou and R. C. Gonzalez: Pattern Recognition Principles, Addison-Wesley, London, 1974.
4. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
5. K. Fukunaga: Introduction to Statistical Pattern Recognition, 2nd eel, Academic Press, New York, 1990.
6. A. K. Jain and R. C. Dubes: Algorithms for Clustering Data, Prentice Hall, Englewood Cliffs, 1988.
7. Neural Networks and Learning Machines, Simon Haykin, Third Edition, PHI Learning, 2009.

Subject Name: SOCIAL NETWORK ANALYSIS					
Paper Code: CSEN4245					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes

1. Students should be able to demonstrate basic knowledge of social networks and related application-oriented models.
2. Students should be able to write programs to implement the related social network analysis algorithms when necessary.
3. Students will get an exposure to the present state-of-the-art algorithms and methods in the area of social networks. This expertise will help them in pursuing research in areas related to social networks.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Pattern Recognition					
Paper Code: CSEN4244					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
Students will be able to:
1. Understand the feature, pattern and the problem of pattern recognition.
2. Describe and explain the difference between supervised and unsupervised learning.
3. Describe and explain pattern recognition algorithm that utilizes supervised learning.
4. Describe and explain pattern recognition algorithm that utilizes unsupervised learning.
5. Design simple pattern recognition systems.

Module – I: Introduction – Definitions, Representations of Patterns and Classes, overview of different approaches, Metric and non-metric measures. Feature selection criteria and algorithms; Minimum distance classifiers, k-NN rule, Discriminant functions (linear and non-linear), parametric and nonparametric learning. (9L)

Module – II: Decision Trees, Bayesian classification, Decision Boundaries, training and test sets, Neural network models for pattern recognition - Perceptron, Multi-layer Perceptron, some applications. (9L)

Module – III: Clustering techniques – Unsupervised learning, basic hierarchical and non-hierarchical clustering algorithms, c-means, fuzzy c-means, DBSCAN, Concepts of hierarchical clustering, Clustering Large datasets. (10L)

Module – IV: dimensionality reduction, principal components analysis, some applications, Some advanced topics with applications, (e.g., neuro-fuzzy approach, genetic algorithms, data mining). (10L)

REFERENCES

1. Devi V.S.; Murty, M.N., Pattern Recognition: An Introduction, Universities Press, Hyderabad, 2011.
2. R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification and Scene Analysis, 2nd ed., Wiley, New York, 2000.
3. 2. J. T. Tou and R. C. Gonzalez: Pattern Recognition Principles, Addison-Wesley, London, 1974.
4. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
5. K. Fukunaga: Introduction to Statistical Pattern Recognition, 2nd eel, Academic Press, New York, 1990.
6. A. K. Jain and R. C. Dubes: Algorithms for Clustering Data, Prentice Hall, Englewood Cliffs, 1988.
7. Neural Networks and Learning Machines, Simon Haykin, Third Edition, PHI Learning, 2009.

Subject Name: SOCIAL NETWORK ANALYSIS					
Paper Code: CSEN4245					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes
1. Students should be able to demonstrate basic knowledge of social networks and related application-oriented models.
2. Students should be able to write programs to implement the related social network analysis algorithms when necessary.
3. Students will get an exposure to the present state-of-the-art algorithms and methods in the area of social networks. This expertise will help them in pursuing research in areas related to social networks.

Module I. Introduction [9L]
Motivating challenges in analysing social networks. **(1L)**
Measures and Metrics (4L):
Degree centrality, Eigenvector centrality, Katz centrality, PageRank, hubs and authorities (HITS), closeness centrality, betweenness centrality, groups of vertices, transitivity, reciprocity, signed edges and structural balance, similarity, homophily and assortative mixing
Large Scale Structure of Networks (4L):
Components, shortest paths and the small world effect, degree distributions, power laws and scale-free networks, distributions of centrality measures, clustering coefficients

Module II. Random Networks [9L]
Understanding mean number of edges, mean degree, degree distribution, clustering coefficient, giant component, small components, and average path lengths for the following models-

Erdos-Renyi Network (3L)
Small-world networks and Watts-Strogatz model (3L)
Preferential attachment and Barabasi-Albert model (3L)

Module III. Propagation of Information in Netowrks [6L]
Contagion Models (3L):
Models of disease spread – SI, SIS, SIR, SIRS and related literature. Outbreak detection.
Influence Maximization (3L):
Influence spread models - independent cascade model, linear threshold model. Maximizing propagation of influence under different setups – greedy approximation algorithm by Kempe et. al. and related literature.

Module IV. Community Detection [12L]
What is a community? Notion of disjoint and overlapping communities. Goodness measures – modularity.
Benchmarks and comparing with the benchmarks (F-measure, NMI, Omega index) **(2L)**
Strength of weak ties and related models. **(1L)**
Clique Percolation model **(1L)**
Modularity maximization, Clauset-Newman-Moore (CNM) method, Louvain Method **(3L)**
Label propagation algorithm and its variants **(2L)**
Random walks, Entropy-based method: Infomap **(2L)**
Community preserving sparsification of social networks **(1L)**

Dr. Subhashis Majumder

Text Books :
1. Networks: An Introduction by Mark Newman. Oxford University Press.

Reference Books :
1. Networks, Crowds and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg.

Subject Name: Mobile Computing					
Paper Code: CSEN4246					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:-

CO1: To be able to understand the difference between Mobile computing and Wireless Networking
CO2: To be able to learn about the wireless networks fundamentals
CO3: To be able to know about the evolution of Wireless Networks

Module I. Introduction [9L]
Motivating challenges in analysing social networks. **(1L)**
Measures and Metrics (4L):
Degree centrality, Eigenvector centrality, Katz centrality, PageRank, hubs and authorities (HITS), closeness centrality, betweenness centrality, groups of vertices, transitivity, reciprocity, signed edges and structural balance, similarity, homophily and assortative mixing
Large Scale Structure of Networks (4L):
Components, shortest paths and the small world effect, degree distributions, power laws and scale-free networks, distributions of centrality measures, clustering coefficients

Module II. Random Networks [9L]
Understanding mean number of edges, mean degree, degree distribution, clustering coefficient, giant component, small components, and average path lengths for the following models-

Erdos-Renyi Network (3L)
Small-world networks and Watts-Strogatz model (3L)
Preferential attachment and Barabasi-Albert model (3L)

Module III. Propagation of Information in Netowrks [6L]
Contagion Models (3L):
Models of disease spread – SI, SIS, SIR, SIRS and related literature. Outbreak detection.
Influence Maximization (3L):
Influence spread models - independent cascade model, linear threshold model. Maximizing propagation of influence under different setups – greedy approximation algorithm by Kempe et. al. and related literature.

Module IV. Community Detection [12L]
What is a community? Notion of disjoint and overlapping communities. Goodness measures – modularity. Benchmarks and comparing with the benchmarks (F-measure, NMI, Omega index) **(2L)**
Strength of weak ties and related models. **(1L)**
Clique Percolation model **(1L)**
Modularity maximization, Clauset-Newman-Moore (CNM) method, Louvain Method **(3L)**
Label propagation algorithm and its variants **(2L)**
Random walks, Entropy-based method: Infomap **(2L)**
Community preserving sparsification of social networks **(1L)**

Text Books :
1. Networks: An Introduction by Mark Newman. Oxford University Press.

Reference Books :
1. Networks, Crowds and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg.

Subject Name: Mobile Computing					
Paper Code: CSEN4246					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:-

CO1: To be able to understand the difference between Mobile computing and Wireless Networking
CO2: To be able to learn about the wireless networks fundamentals
CO3: To be able to know about the evolution of Wireless Networks

CO4: To be accustomed with the modifications necessary in normal IP and TCP protocols to be made suitable for wireless networks
CO5: To have an overview of MANET, LAN, WAN and PAN
CO6: To learn the basic concepts of WAP and WLL
CO7: To learn the basics of Android Operating System
CO8: To be able to develop Android based Applications

Module 1: Introduction to Mobile Communication
Introduction to mobile wireless communication and systems, Description of cellular system. [2L]
Channel interferences. Channel assignment schemes. [2L]

Concept of 1G. Multiple Access Technologies in cellular communication: Time division multiple access (TDMA), Frequency division multiple access (FDMA), Code Division Multiple Access (CDMA). Second generation (2G) Network: Global system for mobile communication (GSM). [2L]

2.5G Wireless Networks-GPRS, CDMA (IS 95), Third Generation 3G Wireless Networks-UMTS, Fourth Generation 4G Wireless Networks-LTE Advanced, Fifth Generation 5G Wireless Networks: Cognitive Radio and Internet of Things. [6L]

Module 2: Mobile Network and Transport Layer
Wireless LAN – IEEE 802.11 [2L]
PAN-Bluetooth- Piconet, Scatternet, Connection Establishment, Protocol Stack [2L]
Recap of Mobile IP, MIPv6 [2L]
Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, ATCP, Transmission / Timeout Freezing Selective Retransmission, Transaction oriented TCP. [4L]

Module 3: Advanced Issues in Mobile Network
Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, routing and various routing algorithms- DSR, WRP,DSDV, AODV,ZRP. Multicast Routing Algorithms: MAODV,ODMRP. [6L]

Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless mark up Languages (WML). [2L]
Cognitive Radio Network, Wireless Sensor Network. [4L]

Module 4: Basics of Android Programming
Android Overview-Environment Setup, Architecture, Application Components, Activities and Services, Content Providers, Fragments, Intents and Filters. [6L]
UI Design and Event Handling-Drag and Drop, Notifications, Location Based Services, Sending Email, Sending SMS, Phone Calls. [6L]

Text Books:

1. Wireless Networks: Applications and Protocols, T.S. Rappaport, Pearson Education
2. Wireless Communications, A. Goldsmith, Cambridge University Press.
3. Wireless Communication: Stallings, Pearson.
4. https://www.tutorialspoint.com/android/
4a. https://developer.android.com/training/basics/firstapp/starting-activity.html
5. Cryptography and Network Security: Atul Kahate.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

OPTIONS FOR ELECTIVE V

CSEN 4261 Distributed Databases
CSEN 4262 Image Processing
CSEN 4263 Soft Computing
CSEN 4264 Machine Learning
CSEN4265 Real Time & Embedded System

Subject Name:	**Distributed Databases**				
Paper Code:	CSEN 4261				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	

Course Educational Objectives:

The main objective of the course is to expose the students to database creation and maintenance in distributed environment.

1. To understand how data is collected and distributed in a database across multiple physical locations
2. To gain knowledge on creating and maintaining databases in distributed environment
3. To learn to manage distributed data with different levels of transparency
4. To acquire knowledge of handling all types of queries, together with query optimization techniques
5. To become familiar with use of database administration tools in a distributed environment

Course Outcomes:

At the end of the course the students will be able to:

1. Demonstrate knowledge on creating and maintaining databases in distributed environment
2. Gain knowledge on handling all types of distributed queries using query optimization techniques
3. Understand how to use query processing layers in distributed multi-DBMS situations
4. Gain familiarity with managing distributed transactions

Text Books:

1. Stefano Ceri and Giuseppe Pelagatti, "Distributed Databases – Principles and Systems", 1st Edition, Tata McGraw-Hill, Edition, 2008
2. M Tamer Ozsu and Patrick Valduriez, "Principles of Distributed Database Systems", 2nd Edition, Pearson Education

Reference Books:

1. Silberschatz, Korth and Sudarshan: Database System Concepts, TMH
2. Ramakrishnan and Gehrke: Database Management Systems, TMH
3. Elmasri and Navathe: Fundamentals of Database Systems, Pearson.

Detailed Syllabus:

5) Module-1: Introduction to Distributed Databases: [06L]
   a) Overview of Distributed Databases: [04L]
      i) Features of Distributed versus Centralized Databases
      ii) Why Distributed Databases?
      iii) Distributed Database Management Systems (DDBMSs)
   b) Recapitulation of Databases and Computer Networks: [02L]
      i) Review of Databases
      ii) Review of Computer Networks
6) Module-2: Principles of Distributed Databases: [12L]
   a) Levels of Distribution Transparency: [06L]
      i) Reference Architecture for Distributed Databases
      ii) Types of Data Fragmentation

iii) Distribution Transparency for Read-only Applications
iv) Distribution Transparency for Read-write Applications
v) Integrity Constraints in Distributed Databases

b) Design of Distributed Database: [06L]
i) A Framework for Distributed Database Design
ii) Design of Database Fragmentation
iii) Allocation of Fragments

7) Module-3: Processing of Distributed Queries: [10L]

a) Translation of Global Queries to Fragment Queries: [06L]
i) Equivalence Transformations for Queries
ii) Transforming Global Queries into Fragment Queries
iii) Distributed Grouping and Aggregate Function Evaluation
iv) Parametric Queries

b) Optimization of Access Strategies: [04L]
i) A Framework for Query Optimization
ii) Join Queries
iii) General Queries

8) Module-4: Management / Administration of Distributed Transactions: [08L]

a) Management of Distributed Transactions: [05L]
i) A Framework for Transaction Management
ii) Supporting Atomicity of Distributed Transactions
iii) Concurrency Control for Distributed Transactions
iv) Architectural Aspects of Distributed Transactions

b) Administration of Distributed Database: [03L]
i) Catalog Management in Distributed Databases
ii) Authorization and Protection

Subject Name: Image Processing					
Paper Code: CSEN 4262					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

COURSE OBJECTIVES:

Major Learning Objectives are:

1. describe and explain basic principles of digital image processing;
2. design and implement algorithms that perform basic image processing (e.g., noise• removal and image enhancement);
3. design and implement algorithms for advanced image analysis (e.g., image compression,• image segmentation);
4. Assess the performance of image processing algorithms and systems.

COURSE OUTCOMES:

Students who complete this course will be able to:

1. Analyze general terminology of digital image processing.
2. Examine various types of images, intensity transformations and spatial filtering.
3. Develop Fourier transform for image processing in frequency domain.
4. Evaluate the methodologies for image segmentation, restoration etc.
5. Implement image process and analysis algorithms.
6. Apply image processing algorithms in practical applications.

iii) Distribution Transparency for Read-only Applications
iv) Distribution Transparency for Read-write Applications
v) Integrity Constraints in Distributed Databases

b) Design of Distributed Database: [06L]
i) A Framework for Distributed Database Design
ii) Design of Database Fragmentation
iii) Allocation of Fragments

7) Module-3: Processing of Distributed Queries: [10L]

a) Translation of Global Queries to Fragment Queries: [06L]
i) Equivalence Transformations for Queries
ii) Transforming Global Queries into Fragment Queries
iii) Distributed Grouping and Aggregate Function Evaluation
iv) Parametric Queries

b) Optimization of Access Strategies: [04L]
i) A Framework for Query Optimization
ii) Join Queries
iii) General Queries

8) Module-4: Management / Administration of Distributed Transactions: [08L]

a) Management of Distributed Transactions: [05L]
i) A Framework for Transaction Management
ii) Supporting Atomicity of Distributed Transactions
iii) Concurrency Control for Distributed Transactions
iv) Architectural Aspects of Distributed Transactions

b) Administration of Distributed Database: [03L]
i) Catalog Management in Distributed Databases
ii) Authorization and Protection

Subject Name: Image Processing					
Paper Code: CSEN 4262					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

COURSE OBJECTIVES:

Major Learning Objectives are:

1. describe and explain basic principles of digital image processing;
2. design and implement algorithms that perform basic image processing (e.g., noise• removal and image enhancement);
3. design and implement algorithms for advanced image analysis (e.g., image compression,• image segmentation);
4. Assess the performance of image processing algorithms and systems.

COURSE OUTCOMES:

Students who complete this course will be able to:

1. Analyze general terminology of digital image processing.
2. Examine various types of images, intensity transformations and spatial filtering.
3. Develop Fourier transform for image processing in frequency domain.
4. Evaluate the methodologies for image segmentation, restoration etc.
5. Implement image process and analysis algorithms.
6. Apply image processing algorithms in practical applications.

COURSE STRUCTURE OF B. TECH IN
COMPUTER SCIENCE & ENGINEERING, HIT

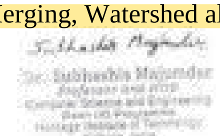
Module I: Introduction [2L] :
Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.
Digital Image Formation [2L]:
A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.
Mathematical Preliminaries [6L]:
Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & Sine Transform.

Module II: Image Enhancement [6L]:
Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.

Digital Image Transforms [4L]:
Basis for transformation, Introduction to Fourier Transform, DFT, FFT, Properties of Fourier Transform, DCT, Walsh Transform, Hadamard Transform, Haar Transform.

Module III: Image Restoration [6L]:
Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.
Image Compression [4L]:
Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Huffman Coding, Arithmetic Coding,LZW coding, Transform Coding, Sub-image size selection, Run length coding, Bit-plane encoding, Bit-allocation, JPEG,Lossless predictive coding, Lossy predictive coding,

Module IV: Morphological Image Processing[4L]:
Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Reconstruction by dilation and erosion.
Image Segmentation [7L] :
Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection - Local Processing, Global Processing via The Hough Transform; Thresholding – Iterative thresholding, Otsu's method, multivariable thresholding, Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging, Watershed algorithm.



References:

1. Digital Image Processing, Gonzalves,Pearson
2. Digital Image Processing, Jahne, Springer India
3. Digital Image Processing & Analysis,Chanda & Majumder,PHI
4. Fundamentals of Digital Image Processing, Jain, PHI
5. Image Processing, Analysis & Machine Vision, Sonka, VIKAS
6. Getting Started with GIS- Clarke Keith. C; PE.
7. Concepts & Techniques of GIS - Lo C.P, Albert, Yeung K.W- PHI.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name:	**Soft Computing**				
Paper Code:	**CSEN 4263**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcome: After going through this course, a student shall be able to -

- Familiarize with soft computing concepts.
- Adopt bio inspired techniques in modeling the real life problems and providing pragmatic solutions.
- Find global optimal solution for complex optimization problems.
- Integrate various soft computing techniques together as and when required.

Module I:

1. Introduction [2 Lectures]

Introduction to Soft Computing, Different tools and Techniques, Usefulness and applications.

2. Fuzzy sets and Fuzzy logic [7 Lectures]

Introduction - Definition, Fuzzy sets versus crisp sets, Fuzzy Membership Functions, Fuzzification & De-Fuzzification, Fuzzy set theoretic operations, Fuzzy Arithmetic, Extension Principle, Fuzzy numbers, Linguistic variables, Fuzzy logic, Linguistic hedges, Fuzzy rules and fuzzy reasoning, Fuzzy inference systems.

Module II:

Artificial Neural Network [9 Lectures]

Introduction, Supervised & Unsupervised Learning, basic models, Hebb's learning, Perceptron, Multilayer feed forward network, Back propagation algorithm, Competitive learning, Self-Organizing Feature Maps, Introduction to Recurrent and Convolution Neural Networks.

Module III:

1. Evolutionary Algorithms [6 Lectures]

Introduction to Genetic Algorithm (GA), GA operators, Schema theorem and convergence of Genetic Algorithm, Applications, Introduction to real coded GA. Introduction to Genetic Programming, Brief overview of Multi-Objective Genetic Algorithm (MOGA).

2. Stochastic Techniques [3 Lectures]

Simulated annealing and stochastic models, Boltzmann Machine, Probabilistic Neural Network

Module IV:

1. Rough Set [3 Lectures]

Introduction to Rough Sets, Indiscernibility Relations, Reducts & Core, Rough Approximation, Decision Matrices, Applications.

2. Swarm Intelligence Techniques [4 Lectures]

Introduction, Key Principles of Swarm, Overview of - Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Artificial Bee Colony Optimization (ABC) techniques with Applications

3. Hybrid Systems [2 Lectures]

ANN Based Fuzzy Systems, Fuzzy Logic Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic and Genetic Algorithm for Optimization, Applications.

Reference Books:

1. Davis E. Goldberg, Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley
2. B. Yegnanarayana, Artificial Neural Networks, PHI
3. S. Rajasekaran and G.A.Vijaylakshmi Pai. Neural Networks Fuzzy Logic, and Genetic Algorithms, Prentice Hall of India
4. Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill
5. K. H. Lee. First Course on Fuzzy Theory and Applications, Springer-Verlag.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name:	**Machine Learning**				
Paper Code:	**CSEN4264**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module – I: The learning Problem: Example of learning, Components of learning, A simple model, Types of learning; The Linear Model I: Input Representation, Linear Classification, Linear and Logistic Regression, Nonlinear Transformation; (9L)

Module – II: Error and Noise; Training vs Testing: From Training to Testing, Dichotomies, Growth Function, key notion: Break Points; The VC Dimension: The definition, VC Dimension of Perceptrons, Interpreting the VC Dimension, Utility of VC Dimension. Bias-Variance Tradeoff: Bias and Variance, Learning Curves;

Module – III: The linear Model II: Logistic Regression, Nonlinear Transformation, Likelihood measure, Gradient Descent; Neural Networks: Neural Network Model, Backpropagation algorithm; Introduction to Radial Basis Function, Recurrent Neural Network, Convolution Neural Network and Deep Neural Network. (9L)

Module – IV: Support Vector Machines (SVM): The Margin, Maximizing the Margin, The solution, Support Vectors, Nonlinear Transform; Kernel Methods: The Kernel methods, Soft-margin SVM; Overfitting: What is overfitting? Dealing with overfitting ; Regularization: Regularization - informal, Regularization – formal, Weight decay, Choosing a regularizer. (9L)

References:

1. Pattern Recognition and Machine Learning. Christopher Bishop. First Edition, Springer, 2006.
2. Pattern Classification. Richard Duda, Peter Hart and David Stock. Second Edition, Wiley-Interscience, 2000.
3. Machine Learning. Tom Mitchell. First Edition, McGraw-Hill, 1997.
4. Computational Intelligence Principles, Techniques and Applications, Amit Konar, Springer, 2012.
5. Neural Networks and Learning Machines, Simon Haykin, Third Edition, PHI Learning, 2009.

Course Outcome:

On completion of the course the student should be able to:

1. Extract features that can be used for a particular machine learning approach in various IOT applications.
2. To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
3. To mathematically analyze various machine learning approaches and paradigms.

Subject Name:	**Real Time and Embedded System**				
Paper Code:	CSEN 4265				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	

COURSE OBJECTIVES

1. To provide a clear understanding on the basic concepts, Building Blocks for Embedded System
2. To introduce on Embedded Process development Environment
3. To be exposed to the basic concepts of real time operating system
4. To familiar with system design techniques and networks for Embedded System

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name:	**Machine Learning**				
Paper Code:	**CSEN4264**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module – I: The learning Problem: Example of learning, Components of learning, A simple model, Types of learning; The Linear Model I: Input Representation, Linear Classification, Linear and Logistic Regression, Nonlinear Transformation; (9L)

Module – II: Error and Noise; Training vs Testing: From Training to Testing, Dichotomies, Growth Function, key notion: Break Points; The VC Dimension: The definition, VC Dimension of Perceptrons, Interpreting the VC Dimension, Utility of VC Dimension. Bias-Variance Tradeoff: Bias and Variance, Learning Curves;

Module – III: The linear Model II: Logistic Regression, Nonlinear Transformation, Likelihood measure, Gradient Descent; Neural Networks: Neural Network Model, Backpropagation algorithm; Introduction to Radial Basis Function, Recurrent Neural Network, Convolution Neural Network and Deep Neural Network. (9L)

Module – IV: Support Vector Machines (SVM): The Margin, Maximizing the Margin, The solution, Support Vectors, Nonlinear Transform; Kernel Methods: The Kernel methods, Soft-margin SVM; Overfitting: What is overfitting? Dealing with overfitting ; Regularization: Regularization - informal, Regularization – formal, Weight decay, Choosing a regularizer. (9L)

References:

1. Pattern Recognition and Machine Learning. Christopher Bishop. First Edition, Springer, 2006.
2. Pattern Classification. Richard Duda, Peter Hart and David Stock. Second Edition, Wiley-Interscience, 2000.
3. Machine Learning. Tom Mitchell. First Edition, McGraw-Hill, 1997.
4. Computational Intelligence Principles, Techniques and Applications, Amit Konar, Springer, 2012.
5. Neural Networks and Learning Machines, Simon Haykin, Third Edition, PHI Learning, 2009.

Course Outcome:

On completion of the course the student should be able to:

1. Extract features that can be used for a particular machine learning approach in various IOT applications.
2. To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
3. To mathematically analyze various machine learning approaches and paradigms.

Subject Name:	**Real Time and Embedded System**				
Paper Code:	CSEN 4265				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	

COURSE OBJECTIVES

1. To provide a clear understanding on the basic concepts, Building Blocks for Embedded System
2. To introduce on Embedded Process development Environment
3. To be exposed to the basic concepts of real time operating system
4. To familiar with system design techniques and networks for Embedded System

COURSE STRUCTURE OF B. TECH IN
COMPUTER SCIENCE & ENGINEERING, HIT

Module I

Introduction to embedded systems: [2L]

Embedded system VS General computing systems, Purpose of Embedded systems

Embedded systems overview with various type of examples in different domains such as in communication systems, robotics application and in control application

Complex systems and micro processors [8L]

Design challenge – optimizing design metrics, embedded processor technology, Microprocessor and Microcontroller.

Embedded system design process –Design example: Model train controller- Instruction sets preliminaries – ARM Processor – CPU: programming input and output- supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance- CPU power consumption

Module II

Devices and Communication Buses: [8L]

I/O types, serial and parallel communication devices, wireless communication devices, timer and counting devices, watchdog timer, real time clock, serial bus communication protocols UART RS232/RS85, parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth. Different types of I/O devices and interfacing: Keypad, LCD, VGA. Design of Control Unit – hardwired and micro programmed control. Horizontal and Vertical instruction. Introduction to I/O interfaces: Interrupts, Interrupt hardware, Enabling and disabling interrupts, Concepts of handshaking, Polled I/O, Memory mapped I/O, Priorities, Stack and Queues. Vectored interrupts, Direct memory access, DMA controller. Sensors and actuators.

Interfacing with Memory & I/O Devices: [6L]

Different types of embedded memory devices and interfacing: SRAM, DRAM, EEPROM, FLASH, CACHE memory. Different types of I/O devices and interfacing: Keypad, LCD, VGA. Square wave and pulse wave generation, LED, A/D converter and D/A Converter interfacing to 8051.

Module III

Real Time operating Systems [10L]

Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, Definition and types of RTOS,

A reference model of Real Time System- Processors, Resources, Temporal parameters, Periodic Task, Aperiodic Task, Sporadic Task

Commonly used approaches to Real Time Scheduling - Clock driven, event driven , Priority based scheduling- Inter-process communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE.

Module IV

System Design Techniques and Networks [4L]

Design methodologies- Design flows – Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques- Distributed embedded systems – MPSoCs and shared memory multiprocessors.

Case Study [4L]

Data compressor – Alarm Clock – Audio player – Software modem-Digital still camera – Telephone answering machine-Engine control unit – Video accelerator.

Course Outcome:

Upon completion of the course, students will be able to:

1. Describe the architecture and programming of ARM processor.
2. Outline the concepts of embedded systems
3. Explain the basic concepts of real time Operating system design.
4. Use the system design techniques to develop software for embedded systems Differentiate between the general purpose operating system and the real time operating system
5. Model real-time applications using embedded-system concepts

Text Book/ References:

1. Embedded System Design: A Unified Hardware/Software Approach – 2nd Ed Frank Vahid and Tony Givargis
2. Computers as Components: Principles of Embedded Computing System Design – 2nd Ed Wayne Wolf.
3. Embedded Real Time Systems Programming, Sriram V Iyer, Pankaj Gupta , Tata Mc-Graw Hill, 2004.
4. Embedded Systems Architecture, .Tammy Noergaard,,Elsevier,2006.
5. Real-Time Systems-Jane W. S. Liu, Pearson Education.

Subject Name: Distributed Database Lab					
Paper Code: CSEN 4271					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	2

Course Educational Objectives:

The main objective of the course is to expose the students to database management in distributed environment using Oracle RDBMS environment

1) To use a range of relevant tools and techniques
2) To design and implement some database application modules
3) To tune and/or optimize some database application modules
4) To become familiar with use of database administration tools in a distributed environment

Course Outcomes:

At the end of the course the students will be able to demonstrate knowledge or skills on using a range of tools and techniques for database management in distributed environment using Oracle RDBMS based tools through:

6. Handling various types of distributed queries using query optimization techniques
7. Matching / Mapping of schema
8. Detecting data inconsistencies based on integrity constraints

Books / References:

1. Oracle 9i Database Concepts from Oracle Corporation
2. Oracle 9i Database Administrator’s Guide from Oracle Corporation
3. Oracle 9i Database Utilities from Oracle Corporation
4. Oracle 9i Performance Tuning Guide from Oracle Corporation

List of Experiments / Assignments (to be chosen from):

Sl.	**Description**
1.	SQL Refresher: Basic DDL and DML (including use of Run-time Variables, Aggregate / Group Functions, Nested Queries / Sub-queries, Joins as well as use of Constraints, Indexes, Sequences, Synonyms, Triggers, Views) – *to be done mostly as Assignments*
2.	PL/SQL Programming: Blocks, Programs, Cursors, Packages, Procedures – *to be done mostly as Experiments*
3.	Some Enhanced DML Features: Inserting into multiple tables using INSERT ALL | FIRST, MERGE statements, Correlated sub-queries (with CASE, GROUP BY … HAVING, DECODE, NVL) – *to be done mostly as Experiments*

4.	Native and Bulk Dynamic SQL: including EXECUTE IMMEDIATE, BULK FETCH, COLLECT INTO, etc. – *to be done mostly as Experiments*
5.	Vertical Fragmentation and Partitioning (both Horizontal and Vertical): – *to be done mostly as Experiments*
6.	Database Links, Location and Statement Transparency, Remote and Distributed SQL Statements: – *to be done as Case Studies*
7.	Data Corruption Detection / Correction: ANALYZE .., VALIDATE STRUCTURE, DBMS_REPAIR, RMAN, etc. – *to be done mostly as Experiments*
8.	Some DBMS Packages: DBMS_DDL, DBMS_JOB, DBMS_OUTPUT, DBMS_SQL, UTL_FILE, UTL_HTTP, UTL_TCP, etc. – *to be done mostly as Experiments*
9.	Bulk Data Loading: SQL*Loader, Bad and Discard Files, Log Files – *to be done mostly as Experiments*

Subject Name: Image Processing Lab					
Paper Code: CSEN 4272					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	2

1. Display of Grayscale Images.
2. Histogram Equalization.
3. Non-linear Filtering.
4. Edge detection using Operators.
5. 2-D DFT and DCT.
6. Filtering in frequency domain.
7. Display of color images.
8. DWT of images.
9. Segmentation using watershed transform.

Subject Name: Soft Computing Lab					
Paper Code: CSEN 4273					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	2

Course Outcome: After going through this course, a student shall be able to -

1. Solve real life problems using Fuzzy Logics.
2. To design different Artificial Neural Network models for solving real life problems.
3. Represent and solve various real life problems using Genetic Algorithm.

A sample assignment list is given below:

Fuzzy Logic:

1. Write a program to implement different Fuzzy Membership functions.
2. Write a program to implement various Fuzzy set operations
3. Write a program to implement composition of Fuzzy and Crisp Relations.
4. Write Matalab code to implement Fuzzy Information System (develop the system using command line and GUI based Fuzzy toolbox)

4.	Native and Bulk Dynamic SQL: including EXECUTE IMMEDIATE, BULK FETCH, COLLECT INTO, etc. – *to be done mostly as Experiments*
5.	Vertical Fragmentation and Partitioning (both Horizontal and Vertical): – *to be done mostly as Experiments*
6.	Database Links, Location and Statement Transparency, Remote and Distributed SQL Statements: – *to be done as Case Studies*
7.	Data Corruption Detection / Correction: ANALYZE .., VALIDATE STRUCTURE, DBMS_REPAIR, RMAN, etc. – *to be done mostly as Experiments*
8.	Some DBMS Packages: DBMS_DDL, DBMS_JOB, DBMS_OUTPUT, DBMS_SQL, UTL_FILE, UTL_HTTP, UTL_TCP, etc. – *to be done mostly as Experiments*
9.	Bulk Data Loading: SQL*Loader, Bad and Discard Files, Log Files – *to be done mostly as Experiments*

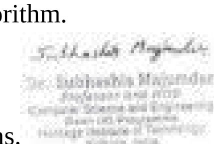
Subject Name: Image Processing Lab					
Paper Code: CSEN 4272					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	2

1. Display of Grayscale Images.
2. Histogram Equalization.
3. Non-linear Filtering.
4. Edge detection using Operators.
5. 2-D DFT and DCT.
6. Filtering in frequency domain.
7. Display of color images.
8. DWT of images.
9. Segmentation using watershed transform.

Subject Name: Soft Computing Lab					
Paper Code: CSEN 4273					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	2

Course Outcome: After going through this course, a student shall be able to -

1. Solve real life problems using Fuzzy Logics.
2. To design different Artificial Neural Network models for solving real life problems.
3. Represent and solve various real life problems using Genetic Algorithm.



A sample assignment list is given below:

Fuzzy Logic:

1. Write a program to implement different Fuzzy Membership functions.
2. Write a program to implement various Fuzzy set operations
3. Write a program to implement composition of Fuzzy and Crisp Relations.
4. Write Matalab code to implement Fuzzy Information System (develop the system using command line and GUI based Fuzzy toolbox)

4.	Native and Bulk Dynamic SQL: including EXECUTE IMMEDIATE, BULK FETCH, COLLECT INTO, etc. – *to be done mostly as Experiments*
5.	Vertical Fragmentation and Partitioning (both Horizontal and Vertical): – *to be done mostly as Experiments*
6.	Database Links, Location and Statement Transparency, Remote and Distributed SQL Statements: – *to be done as Case Studies*
7.	Data Corruption Detection / Correction: ANALYZE .., VALIDATE STRUCTURE, DBMS_REPAIR, RMAN, etc. – *to be done mostly as Experiments*
8.	Some DBMS Packages: DBMS_DDL, DBMS_JOB, DBMS_OUTPUT, DBMS_SQL, UTL_FILE, UTL_HTTP, UTL_TCP, etc. – *to be done mostly as Experiments*
9.	Bulk Data Loading: SQL*Loader, Bad and Discard Files, Log Files – *to be done mostly as Experiments*

Subject Name: Image Processing Lab					
Paper Code: CSEN 4272					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	2

1. Display of Grayscale Images.
2. Histogram Equalization.
3. Non-linear Filtering.
4. Edge detection using Operators.
5. 2-D DFT and DCT.
6. Filtering in frequency domain.
7. Display of color images.
8. DWT of images.
9. Segmentation using watershed transform.

Subject Name: Soft Computing Lab					
Paper Code: CSEN 4273					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	3	3	2

Course Outcome: After going through this course, a student shall be able to -

1. Solve real life problems using Fuzzy Logics.
2. To design different Artificial Neural Network models for solving real life problems.
3. Represent and solve various real life problems using Genetic Algorithm.

A sample assignment list is given below:

Fuzzy Logic:

1. Write a program to implement different Fuzzy Membership functions.
2. Write a program to implement various Fuzzy set operations
3. Write a program to implement composition of Fuzzy and Crisp Relations.
4. Write Matalab code to implement Fuzzy Information System (develop the system using command line and GUI based Fuzzy toolbox)

Neural network:

5. Write a program to implement McCulloch-Pitts neural network for generate AND, OR functions.
6. Write a program to implement Perceptron (including MLP) learning for particular set of problems.

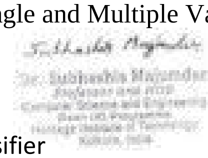
Genetic Algorithm

7. Write a program for maximizing single and multiple variables functions in a given domain, e.g., $F(x) = (x-2)^2 + \sin(x+3)$, $-31 < x < 31$ using Genetic Algorithm.
8. Use of Genetic Algorithm toolbox in MATLAB for optimization problem solving.
9. Implementation of Simple Genetic Algorithms in C for solving real life problems.

Subject Name:	**Machine Learning Lab**				
Paper Code:	**CSEN4274**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

1. Linear Regression with single and Multiple Variables

2. Non-linear Regression



3. Classifiers
   1. K-NN
   2. Naïve Bayes Classifier
   3. Perceptron
   4. Multi Layer Perceptron

4. Clustering Algorithms
   1. K-Means
   2. DB-Scan

5. Applications of ANN and SVM using tools
6. Familiarization with a few ML Tools
   1. Excel
   2. WEKA
   3. R
   4. Python
   5. TensorFlow

Neural network:

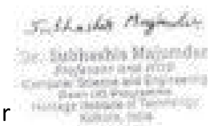
5. Write a program to implement McCulloch-Pitts neural network for generate AND, OR functions.
6. Write a program to implement Perceptron (including MLP) learning for particular set of problems.

Genetic Algorithm

7. Write a program for maximizing single and multiple variables functions in a given domain, e.g., $F(x) = (x-2)^2 + \sin(x+3)$, $-31 < x < 31$ using Genetic Algorithm.
8. Use of Genetic Algorithm toolbox in MATLAB for optimization problem solving.
9. Implementation of Simple Genetic Algorithms in C for solving real life problems.

Subject Name:	**Machine Learning Lab**				
Paper Code:	**CSEN4274**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

1. Linear Regression with single and Multiple Variables
2. Non-linear Regression
3. Classifiers
    1. K-NN
    2. Naïve Bayes Classifier
    3. Perceptron
    4. Multi Layer Perceptron



4. Clustering Algorithms
    1. K-Means
    2. DB-Scan
5. Applications of ANN and SVM using tools
6. Familiarization with a few ML Tools
    1. Excel
    2. WEKA
    3. R
    4. Python
    5. TensorFlow

4th Year 1st Semester:

Course Name : INTERNET TECHNOLOGY					
Course Code: INFO4101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

After successfully completing this course the students will be able to:

Detailed Syllabus:

Module I-[10L]

Overview of JavaScript:

What is JavaScript? Brief history. Common use-cases. Runtime environments. ECMA Script standards. Basic syntax, Arrays and Objects, Functions, Document Object Model, String interpolation, let and const, Arrow functions, Destructuring , Symbol, Maps and Sets, for-of , Spread operator , Classes , Promises , Module loaders, Typed Arrays.

Module II-[10L]

jQuery :

Overview of jQuery. Cross-browser compatibility. The $ function object. Element selectors. Tree traversal. Node creation, insertion, modification and deletion. Getting and setting attributes, styles and class. Wrapping and unwrapping DOM raw objects. The chaining pattern, Event handling. bind and unbind. Keyboard and mouse events. Event delegation and bubbling. Animation. AJAX with jQuery

Javascript Context, Closures & Higher-order Functions:

Object method invocation, implicit parameter variable, Event handlers and callbacks, Usage of call and apply, Binding context, new keyword. Lexical scope, Inner functions, Closure scope, Functors. Simulation of private object properties. Simulation of namespaces. Functional programming. Referential transparency. Iteration over collections without loops. Implementation of map, reduce, find, filter.

Module III-[10L]

TypeScript : Introduction to TypeScript, From TS to JS, Types and Type Inference, Classes, Interfaces, Modules, Internal Modules, External Modules, TypeScript Definition files (TSD)

Node.js & Backbone.js : Server-side scripting. Threaded vs event-based server models. Working with callbacks. The Express web framework, Backbone.js

TBD & HTML 5 APIs: Anatomy of a javascript module, design, layout and components of a typical javascript library ,HTML 5 APIs

d3.js : Data visualization. Drawing graphics using SVG. Selections with select and selectAll. Adding and deleting elements with enter and exit, Binding data with data, Animation with transition.

Module IV-[10L]

MVC and Angular in HTML: Angular, MVC, MVW, Survey

Angular Form: Controllers, ng-model, Survey, Testing Controllers

Angular Services: Services, Survey, Testing Services

Angular Directives: Directives, Survey

Angular Routes: $http, Routes

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

References:

1. JavaScript: The Good Parts by Douglas Crockford, O'Reilly Media
2. JavaScript: The Definitive Guide by David Flanagan, O'Reilly Media
3. Dive Into HTML5 by Mark Pilgrim
4. Learning Advanced Javascript by John Resig by Apress
5. Angular JS by Green and Brad, O'Reilly
6. Professional AngularJS by Valeri Karpov, Diego Netto (WROX)

<table>
<tr><td colspan="6">Course Name : IMAGE PROCESSING</td></tr>
<tr><td colspan="6">Course Code: INFO4102</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td><td>4</td></tr>
</table>

After successfully completing this course the students will be able to:

1) Compare the performance of the Roberts, Sobel and Prewitt edge detection operators.
2) Design the different spatial domain filters such as max, min, median and box filter.
3) Evaluate the performance of different transforms like DFT, DCT and DWT.
4) Describe the image formation model in digital computer.
5) Find the distance between two pixels using Euclidean Distance, City-block distance and Chessboard distance.

Detailed Syllabus:

Module-I: [9L]

Introduction: Overview of Image Processing, Application area of image processing, Digital Image Representation, Sampling & quantization. Spatial and Intensity resolution, interpolation, Relationship between pixels – Neighbors, Adjacency, connectivity, Regions, Boundaries and Distance,

Image Enhancement in Spatial Domain: Image Quality and Need for image enhancement, Intensity transformation – negative, log, power-law and contrast stretching (linear and non-linear) Histogram based techniques, Spatial Filtering concepts, Spatial Convolution and Correlation, Image smoothing and Sharpening spatial filters,

Module – II: [9L]

Image Enhancement in Frequency Domain: Properties of 1-D and 2-D Discrete Fourier Transform (DFT), Basic of filtering in the frequency domain. Image smoothing and sharpening in frequency domain.

Image Restoration: Introduction to degradation, Types of Image degradations, image degradation models, noise modeling, Estimation of degradation functions, Image restoration in presence of noise only – spatial filtering, Periodic noise and band – pass and band reject filtering.

Module – III: [10L]

Image Compression: coding redundancy, Image compression model, Compression Methods – Huffman coding, Arithmetic coding, LZW coding, Run-length coding, Predicative coding and Vector quantization

Module – IV: [10L]

Image Segmentation: Introduction, Detection of Discontinuities, Point Detection, Line Detection and Edge Detection, Thresholding – Local, Global, Optimum, Multiple and Variable, Hough Transforms, Principle of region – growing, splitting and merging.

References:

1. Rafael C. Gonzalez, Richard E woods, Digital Image Processing, Pearson.
2. Rafael C. Gonzalez, Richard E woods, Digital Image Processing Using MATLAB, Gatesmark Publishing.
3. Anil K Jain, „"Fundamentals of Digital Image Processing", Pearson.
4. S. Sridhar, "Digital Image Processing", OXFORD University Press, Second Edition.
5. Bhabatosh Chanda, Dwijesh Dutta Majumder, Digital Image Processing and Analysis, Prentice Hall of India

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : DISTRIBUTED OPERATING SYSTEM					
Course Code: INFO4141					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

After successfully completing this course the students will be able to:

1) Find out the way in which several machines orchestrate to correctly solve problems in an efficient, reliable and scalable way.
2) Understand key mechanisms and models for distributed systems including logical clocks, causality, vector timestamps, distributed hash tables, consistent global states, election algorithms, distributed mutual exclusion, consistency, replication, fault tolerance, distributed deadlocks, recovery, agreement protocols
3) Learn how to design and implement distributed algorithms
4) Practice with mechanisms such as client/server and P2P algorithms, remote procedure call (RPC/RMI), multicasting
5) Exposed to various areas of research in distributed systems.
6) Learn to design the fault tolerant distributed systems.

Detailed Syllabus:

Module-I: [9L]

Introduction to Distributed System: Introduction, Examples of distributed system, Resource sharing, Challenges

Operating System Structures: Review of structures: monolithic kernel, layered systems, virtual machines. Process based models and client server architecture; The micro-kernel based client-server approach.

Communication: Inter-process communication , Remote Procedure Call, Remote Object Invocation, Tasks and Threads. Examples from LINUX, Solaris 2 and Windows NT.

Module-II: [10L]

Theoretical Foundations: Introduction. Inherent Limitations of distributed Systems. Lamport's Logical clock. Global State: Chandy Lamport's Global State Recording Algorithm

Distributed Mutual Exclusion: Classification of distributed mutual exclusion algorithm. NonToken based Algorithm:Lamport's algorithm,Ricart-Agrawala algorithm. Token based Algorithm: Suzuki-Kasami's broadcast algorithm. A comparative performance analysis of different algorithms w.r.t Response time, Synchronoization delay, Message traffic, Universal prformance bound.

Distributed Deadlock Detection: Deadlock handling strategies in distributed systems . Control organizations for distributed deadlock detection. Centralized and Distributed deadlock detection algorithms: Completely Centralized algorithms, path pushing, edge chasing, global state detection algorithm.

Module-III: [10L]

Protection and Security: Requirements for protection and security regimes. The access matrix model of protection. System and user modes, rings of protection, access lists, capabilities. User authentication, passwords and signatures. Use of single key and public key encryption.

Distributed file systems: Issues in the design of distributed file systems: naming, writing policiy, Cache consistency, Availability, Scalability and Semantics. Use of the Virtual File System layer. Case Studies: Sun NFS, The Sprite File System, CODA, The x-Kernel Logical File System.

Module-IV: [7L]

Distributed Shared Memory: Architecture and motivations. Algorithms for implementing DSM: The Central-Server Algorithm, The MigrationAlgorithm, The Read-Replication Algorithm, The Full-Replication Algorithm. Memory Coherence. Case Studies: IVY, Clouds.

Distributed Scheduling: Issues in Load Distributing: Load, Classification of Load Distribution, Load Balancing vs Load Sharing, Preemptive vs Nonpreemptive; Components of a load distribution; Stability.

Prof. (Dr.) Siuli Roy

References:

1. Andrew S. Tanenbaum and Maarten Van Steen, Distributed Systems Principles and Paradigms, PHI
2. Singhal Mukesh & Shivaratri N. G., Advanced Concepts in Operating Systems, TMH
3. Tanenbaum, A. S. Distributed Operating Systems, (ISBN 0-131-439-340), Prentice Hall 199
4. Tanenbaum, A. S. Modern Operating Systems, 2ndEdition (ISBN 0-13-031358-0), Prentice Hall 2001.
5. Bacon, J., Concurrent Systems, 2nd Edition, (ISBN 0-201-177-676), Addison Wesley 1998.
6. Silberschatz, A., Galvin, P. and Gagne, G., Appl ied Operating Systems Concepts, 1st Edition, (ISBN 0-471-36508-4), Wiley 2000.
7. Coulouris, G. et al, Distributed Systems: Concepts and Design, 3rd Edition, (ISBN 0-201- 61918-0), Addison Wesley 2001.

Course Name : CYBER LAW & SECURITY POLICY					
Course Code: INFO4142					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

After successfully completing this course the students will be able to:

1) Defining the concept of Cybercrime, Forgery, Hacking, Software Piracy and Network Intrusion.
2) Discuss the concept of Cyber Stalking and different methods of Active attack and Passive attack with examples.
3) Analyze the security challenges posted by mobile devices, Explain the attacks on mobile/Cell phones and Differentiate between different viruses on laptop. Explain the concepts of Trojan Horses, Backdoors, DOS & DDOS attacks, SQL injection and Buffer Overflow.
4) Compare different methods of Phishing, ID Theft and Discuss Digital Forensics analysis with guidelines of Cell phone forensics.

Detailed Syllabus:

Module-I: [10L]
***Introduction of Cybercrime*:** What is cybercrime? Forgery, Hacking, Software Piracy, Computer Network intrusion
Category of Cybercrime: How criminals plan attacks, Passive attack, Active attacks, Cyberstalking.

Module – II: [10L]
Cybercrime Mobile & Wireless devices: Security challenges posted by mobile devices, Cryptographic security for mobile devices, Attacks on mobile/cell phones, Keyloggers & Spywares, Virus& Worms, Hacking and Phishing.

Module-III: [10L]
Tools and Methods used in Cyber crime: Proxy servers, password checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection, Buffer over flow.

Module-IV: [10L]
***Phishing & Identity Theft*:** Phishing methods, ID Theft; Online identity method.
***Digital Forensic*:** Introduction to Digital Forensic, Steps of Forensic investigation, Tools for Digital forensic analysis and Organizational guidelines for Cell phone Forensics.

References:

1. Cyber security by Nina Gobole & Sunit Belapune; Pub: Wiley India.

Siuli Ray

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : FUNDAMENTALS OF CLOUD COMPUTING					
Course Code: INFO4143					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

After successfully completing this course the students will be able to:
learn cloud computing models, techniques, and architectures. Cloud computing has evolved as a very important computing model, which enables information, software, and other shared resources to be provisioned over the network as services in an on-demand manner. Students will be exposed to the current practices in cloud computing. Topics may include distributed computing models and technologies, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), virtualization, security and privacy issues, performance and systems issues, capacity planning, disaster recovery, challenges in implementing clouds, data centers, cloud hosted applications, and other advanced and research topics in cloud computing.

Detailed Syllabus:

Module-I: [7 L]

Overview of Computing Paradigm: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing

Introduction to Cloud Computing: Cloud Computing definition, Deployment Models: private, public, hybrid, community cloud. Service Models: IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds

Module-II: [13 L]

Cloud Virtualization: Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM). Resource Virtualization: Server, Storage, Network

Cloud Computing Architecture: Assumptions, Recommendations and fundamental requirements for cloud application architecture. SOA for cloud applications. Open-Source Eucalyptus Cloud Architecture.

Module-III: [11 L]

Service Management in Cloud Computing: IT Infrastructure Library based Service Management: Service Strategy, Service Design, Service Transition, Service Operation, Continual Service Improvement Concept of SLA. SLA aspects and requirements

Cloud Risk and Security: Type of Risk in cloud, Risk management, cloud security services(Confidentiality, Integrity, Availability), application security in IaaS, PaaS, SaaS environment.

Module-IV: [11 L]

Cloud Cost: Direct and Indirect Cost, Chargeback Models, Methodology, Tools and Solution

Cloud Applications: Microsoft Cloud Services, Google cloud Applications, Amazon Cloud Services, Mobile Cloud

References:

1. *Cloud Computing Black Book*, Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah, *dreamtech Press*
2. *Cloud Computing A practicle approach for learning and implementation,* A. Srinivasan, J. Suresh, *Pearson*
3. *Cloud Computing Bible*, Barrie Sosinsky, *Wiley-India*, 2010
4. *Cloud Computing: Principles and Paradigms,* Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, *Wile*, 2011
5. *Cloud Computing: Principles, Systems and Applications, Editors:* Nikos Antonopoulos, Lee Gillam, *Springer*, 2012
6. *Cloud Security: A Comprehensive Guide to Secure Cloud Computing*, Ronald L. Krutz, Russell Dean Vines, *Wiley-India*, 2010

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : INTERNET TECHNOLOGY LABORATORY					
Course Code: INFO4111					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**2**

After successfully completing this course the students will be able to:

Detailed Syllabus:

- JavaScript
- jQuery
- Javascript Context, Closures & Higher-order Functions
- TypeScript
- Node.js & Backbone.js
- TBD & HTML 5 APIs
- d3.js
- Modularization (RequireJS)
- Testing and TDD/BDD (Jasmine)
- Test Running (Karma)
- NPM and Task Running (Gulp)
- Dependency Management (Bower)
- MVC and Angular in HTML
- Angular Forms
- Angular Services
- Angular Directives
- Angular Routes
- Node and APIs
- Node Express

References:

1. Angular JS by Green and Brad, O'Reilly
2. Professional AngularJS by Valeri Karpov, Diego Netto (WROX)
3. JavaScript: The Good Parts by Douglas Crockford, O'Reilly Media
4. JavaScript: The Definitive Guide by David Flanagan, O'Reilly Media

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

<table>
<tr><td colspan="6">Course Name : IMAGE PROCESSING LABORATORY</td></tr>
<tr><td colspan="6">Course Code: INFO4112</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>2</td></tr>
</table>

After successfully completing this course the students will be able to:

1) Apply different MATLAB library functions such as imread, imresize, size, imshow, fft and imhist to process an image.
2) Develop different image processing algorithms like filtering, noise removal and segmentation in MATLAB language.
3) Evaluate the performance of the spatial mask based on their size (3x3, 5x5, 7x7)

Detailed Syllabus:

1. Introduction – MATLAB image processing toolbox
2. Transformation – negative, log, power-law
3. contrast stretching - linear and non-linear
4. Histogram of an image and Histogram Equalization
5. Spatial Filters – Box, mean, max and median etc.
6. Fourier Transformation of an image
7. Implement high-pass, low-pass and band-pass filters
8. Remove the noise from the input images
9. Point Detection, Line Detection and Edge Detection
10. Thresholding – Local, Global, Optimum, Multiple and Variable,
11. Implement region growing, splitting and merging algorithms.
12. Project on image processing

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name: PARALLEL COMPUTING					
Course Code: INFO4241					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

After successfully completing this course the students will be able to:

Detailed Syllabus:

Module-I: [8L]
Foundations Of Parallel Programming: Introduction.-Parallel Processing Environment- Pipelining and Data Parallelism, Scalability, Flynn's Taxonomy
Parallel Algorithms: Structure, cost, Analysis ;Elementary Algorithms: Broadcast, Prefix sums, All sums, Algorithms on Selection problem, Merging-Odd-even merging network, CREW Merging, N-ary searching Matrix Transposition ,Matrix Multiplications- 2D Mesh SIMD ,Hypercube SIMD, Shuffle-Exchange SIMD models.

Module-II: [8L]
Analytical modeling of program performance: speedup, efficiency, scalability, cost optimality
Linear system of equations: Gaussian Elimination, Gauss-Seidel algorithm, Jacobi algorithm
Sorting: Enumeration sort, Odd-even transposition sort, Bitonic merge, Ellis's Algorithm

Module-III: [9L]
Message Passing Paradigm: Basic MPI programming – MPI_Init and MPI_Finalize - message passing – MPI_Send and MPI_Recv - message matching - remote memory access – dynamic process management – MPI for grids – performance evaluation of MPI programs
Shared Memory Paradigm*: *OPENMP
Basic OpenMP constructs – scope of variabls – reduction clause – parallel for directive – loops in OpenMP – scheduling loops – synchronization in OpenMP – Case Study: Producer-Consumer problem – cache issues – threads safety in OpenMP – OpenMP best practices

Module-IV: [9L]
Shared Memory Paradigm: PTHREADS
Basics of Pthreads – thread synchronization – critical sections – busy-waiting – mutexes - Semaphores – barriers and condition variables – read-write locks – Caches, cache coherence and false sharing – thread safety – Pthreads case study
Graphical Processing Paradigms: OPENCL
Introduction to OpenCL – OpenCL programming examples – Programs and Kernels – Buffers and Images – Event model – OpenCL case study

References:

1. Parallel Computing –Theory and Practice -Michael J. Quinn (McGraw Hill Inc.)
2. Design and Analysis of Parallel Algorithms- S.G. Akl (PH)

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name: NATURAL LANGUAGE PROCESSING					
Course Code: INFO4242					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

After successfully completing this course the students will be able to:

1. Learn the techniques in natural language processing.
2. Be familiar with the natural language generation.
3. Be exposed to machine translation.
4. Understand the information retrieval techniques.

Detailed Syllabus:

Module-I: [13L]
Overview and language modeling [6L]
Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval.
Word level and syntactic analysis [7L]
Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging.
Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

Module-II: [11L]
Semantic analysis and discourse processing
Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation.
Discourse Processing: cohesion-Reference Resolution- Discourse Coherence and Structure.

Module-III: [12L]
Natural language generation and machine translation
Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG.
Machine Translation: Problems in Machine Translation- Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages.

Module-IV: [12L]
Information retrieval and lexical resources
Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – evaluation
Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

References:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Prentice Hall, 2008.
3. James Allen, "Natural Language Understanding", 2nd edition, Benjamin /Cummings publishing company, 1995.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name: CRYPTOGRAPHY & NETWORK SECURITY					
Course Code: INFO4243					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

<u>After successfully completing this course the students will be able to:</u>

1) Defining the concepts of Network security and identifying different types of attack on Network security. Recall the principles of security.
2) Classify different kinds of Substitution techniques and Transposition techniques and discuss the concepts of Symmetric key cryptography and Asymmetric key cryptography. Explaining in detail DES, RSA, IDEA and RC5 algorithm.
3) Prepare and practice numerical module based on DES and RSA. Illustrating the concept of SSL,PGP, PEM, Authentication token and Digital Signature. Explain Message Digest and Hash function in accordance with the prescribed syllabus.
4) Analyze Certificate based Authentication, Biometric Authentication and differentiate between different types of Authentication tokens.
5) Explain concepts of Firewall (including types of Firewall), DMZ Network and comparing between different Firewall Configurations.

<u>Detailed Syllabus:</u>

Module-I: [10L]
Network Security and Cryptography- Concepts and Techniques
Need for Security, Security approaches, Principles of Security, Types of attack on security. Introduction to cryptography, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Type of attacks on encrypted text, Symmetric & Asymmetric key Cryptography.

Module-II: [10L]
Symmetric Key Algorithms
Algorithm types & Modes, Overview of Symmetric Key Cryptography, Diffie-Hellman key exchange algorithm, Digital Envelope, DES(Data Encryption Standard) algorithm & its variant, IDEA(International Data Encryption Algorithm) algorithm, RC5(Rivest Cipher 5) algorithm.

Module-III: [10L]
Asymmetric Key Algorithms, Digital Signature and User Authentication
Overview of Asymmetric key Cryptography, RSA algorithm, Digital Signature, Basic concepts of Message Digest and Hash Function (Algorithms on Message Digest and Hash function not required), HMAC algorithm. Authentication Basics, Password, Authentication Token, Certificate based Authentication and Biometric Authentication.

Module-IV: [10L]
Electronic mail security, SSL and Firewall
Basics of mail security, PEM, PGP, S/MIME, Secure Socket Layer (SSL) protocol. Introduction to Firewall, Types of firewall, Firewall Configurations and DMZ Network.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

References:

1. “Cryptography and Network Security”, William Stallings, 2nd Edition, Pearson Education Asia
2. “Network Security private communication in a public world”, C. Kaufman, R. Perlman and M. Speciner, Pearson
3. Cryptography & Network Security: Atul Kahate, TMH.
4. “Network Security Essentials: Applications and Standards” by William Stallings, Pearson.
5. “Designing Network Security”, Merike Kaeo, 2nd Edition, Pearson Books
6. “Building Internet Firewalls”, Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2nd Edition, Oreilly
7. “Practical Unix & Internet Security”, Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly

Course Name: SOFT COMPUTING					
Course Code: INFO4244					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

After successfully completing this course the students will be able to:

1) Identify the Intractable problems like NP – complete, NP- hard problems and reproduce the optimal solution instead Optimum.
2) Determine the complexity of computation and reduce the complexity to interpret the real problems.
3) Assemble different techniques to sketch a hybrid system for better result.
4) Able to interpret the problem in terms time and space.
5) Justify the optimal solution and able to predict the running time of the program.

Detailed Syllabus:

Module-I: [9L]

Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing.

Genetic algorithm: Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Multi-objective Genetic Algorithm (MOGA).

Applications of Genetic Algorithm: genetic algorithms in search and optimization, GA based clustering Algorithm

Module-II: [8L]

Fuzzy sets and Fuzzy logic systems:

Classical Sets and Fuzzy Sets and Fuzzy relations: Operations on Classical sets, properties of classical sets, Fuzzy set operations, properties of fuzzy sets, cardinality, operations, and properties of fuzzy relations.

Membership functions : Features of membership functions, standard forms and boundaries, different fuzzification methods.

Fuzzy to Crisp conversions: Lambda Cuts for fuzzy sets, fuzzy Relations, Defuzzification methods.

Classical Logic and Fuzzy Logic: Classical predicate logic, Fuzzy Logic, Approximate reasoning and Fuzzy Implication

Fuzzy Rule based Systems: Linguistic Hedges, Fuzzy Rule based system – Aggregation of fuzzy Rules

Applications of Fuzzy Logic: How Fuzzy Logic is applied in Home Appliances

Module-III: [9L]

Neural Network: Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference between ANN and human brain, characteristics and applications of ANN, single layer network, Perceptron training algorithm,Linear separability, Hebb's learning rule/Delta rule, ADALINE, MADALINE

Introduction of MLP: Different activation functions, Error back propagation algorithm, derivation of BBPA, momentum, limitation, characteristics and application of EBPA, Hopfield/ Recurrent network, configuration, stability constraints

Module-IV: [9L]

Associative Memory and characteristics, limitations and applications. Hopfield v/s Boltzman machine.

Adaptive Resonance Theory: Architecture, classifications, Implementation and training.

Applications of Neural Networks: Pattern Recognition and classification

Other Soft Computing Approaches: Ant Colony Optimization (ACO) and Particle Swarm Optimization (PSO)

Hybrid Approaches: Nuro-Fuzzy modeling, ANN-GA Modeling

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

References:

1. Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.
2. S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI
3. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg
4. Neural Networks: A Comprehensive Foundation (2nd Edition), Simon Haykin, Prentice Hall.

4th Year 1st Semester:

Course Name : CYBER CRIME & CYBER SECURITY					
Course Code: INFO4181					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

After successfully completing this course the students will be able to:

1) Defining the concept of Cybercrime, Forgery, Hacking, Software Piracy and Network Intrusion.
2) Discuss the concept of Cyber Stalking and different methods of Active attack and Passive attack with examples.
3) Analyze the security challenges posted by mobile devices, specify the attacks on mobile/Cell phones and differentiate between different viruses on laptop. Outline the concepts of Trojan Horses, Backdoors; DOS & DDOS attacks; SQL injection and Buffer Overflow.
4) Compare different methods of Phishing and ID Theft. Explain Homograph attack, Spear Phishing, Whaling and Geotagging.

Detailed Syllabus:

Module - I: [7L]
Introduction of Cybercrime: Cybercrime- Definition & Concepts, Cybercriminals, Classification of Cybercrimes.
Category of Cybercrime: How criminals plan attacks? Passive attack, Active attacks, Cyberstalking.

Module - II: [8L]
Cybercrime Mobile & Wireless devices: Techniques of Credit card Fraud, Security challenges posted by mobile devices, Cryptographic security for mobile devices, Attacks on mobile/cell phones, Keyloggers & Spywares, Virus & Worms.

Module - III: [10L]
Tools and Methods used in Cyber crime: Stages of Network attack, Proxy servers & Anonymizers, Strong, Weak & Random password, Trojan Horse and Backdoors; DOS & DDOS attacks, Blended Threat and PDoS attack.

Module - IV: [10L]
Phishing & Identity Theft: Phishing methods, Phishing Techniques, Homograph attack, Spear Phishing & Whaling, Phishing Scams ID Theft: Types & Techniques, Geotagging.

References:

1. Cyber security by Nina Gobole & Sunit Belapune; Pub: Wiley India.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name : CLOUD COMPUTING					
Course Code: INFO4182					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

After successfully completing this course the students will be able to:
learn cloud computing models, techniques, and architectures. Cloud computing has evolved as a very important computing model, which enables information, software, and other shared resources to be provisioned over the network as services in an on-demand manner. Students will be exposed to the current practices in cloud computing. Topics may include distributed computing models and technologies, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), virtualization, security and privacy issues, performance and systems issues, capacity planning, disaster recovery, challenges in implementing clouds, data centers, cloud hosted applications, and other advanced and research topics in cloud computing.

Detailed Syllabus:

Module-I: [7L]
Overview of Computing Paradigm: Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing
Introduction to Cloud Computing: Cloud Computing, Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Properties, Characteristics & Disadvantages
Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing

Module-II: [11L]
Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services
Service Models (XaaS): Infrastructure as a Service (IaaS), Platform as a Service(PaaS), Software as a Service(SaaS)
Deployment Models: Public cloud, Private cloud. Hybrid cloud, Community cloud
Infrastructure as a Service(IaaS): Introduction to IaaS, IaaS definition, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM)
Resource Virtualization: Server, Storage, Network, Virtual Machine (resource) provisioning and manageability, storage as a service, Data storage in cloud computing (storage as a service), Examples: Amazon EC2, Renting, EC2 Compute Unit, Platform and Storage, pricing, customers

Module-III: [11L]
Platform as a Service(PaaS): Introduction to PaaS, What is PaaS, Service Oriented Architecture (SOA)
Cloud Platform and Management: Computation, Storage, Examples: Google App Engine, Microsoft Azure
Software as a Service(SaaS): Introduction to SaaS, Web services. Web 2.0, Web OS

Module-IV: [12L]
Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously, Managing Data: Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing
Cloud Security: Infrastructure Security, Network level security, Host level security, Application level security: Data security and Storage, Data privacy and security Issues: Identity & Access Management, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

References:

1. *Cloud Computing Bible*, Barrie Sosinsky, *Wiley-India*, 2010
2. *Cloud Computing: Principles and Paradigms,* Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, *Wile,* 2011
3. *Cloud Computing: Principles, Systems and Applications, Editors:* Nikos Antonopoulos, Lee Gillam, *Springer,* 2012
4. *Cloud Security: A Comprehensive Guide to Secure Cloud Computing,* Ronald L. Krutz, Russell Dean Vines, *Wiley-India,* 2010

4th Year 2nd Semester:

Course Name: FUNDAMENTALS OF CRYPTOGRAPHY					
Course Code: INFO4281					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	3

After successfully completing this course the students will be able to:

1) Defining the concepts of Network security and identifying different types of attack on Network security. Recall the principles of security.
2) Classify different kinds of Substitution techniques and Transposition techniques and discuss the concepts of Symmetric key cryptography and Asymmetric key cryptography. Explaining in detail DES, RSA and IDEA algorithm.
3) Prepare and practice numerical module based on DES and RSA. Illustrating the concept of SSL, PEM, Authentication token and Digital Signature. Explain Message Digest and Hash function in accordance with the prescribed syllabus.
4) Analyze Certificate based Authentication, Biometric Authentication and differentiate between different types of Authentication tokens.
5) Explain concepts of Firewall (including types of Firewall), DMZ Network and comparing between different Firewall Configurations.

Detailed Syllabus:

Module-I: [7L]

Cryptography- Concepts and Techniques: Introduction to cryptography, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Type of attacks on encrypted text, Symmetric & Asymmetric key Cryptography and Digital envelope.

Module-II: [8L]

Symmetric Key Algorithms: Algorithm types & Modes, Overview of Symmetric Key Cryptography, Diffie-Hellman key exchange algorithm, DES (Data Encryption Standard) algorithm & its variant, IDEA(International Data Encryption Algorithm) algorithm.

Module-III: [10L]

Asymmetric Key Algorithms, Digital Signature and User Authentication: Overview of Asymmetric key Cryptography, RSA algorithm, Digital Signature, Basic concepts of Message Digest and Hash Function (Algorithms on Message Digest and Hash function not required), HMAC algorithm. Authentication Token, Certificate based Authentication and Biometric Authentication.

Module-IV: [8L]

Electronic mail security, SSL and Firewall: PEM, Secure Socket Layer (SSL) protocol. Introduction to Firewall, Types of firewall, Firewall Configurations and DMZ Network.

References :

1. "Cryptography and Network Security", William Stallings, 2nd Edition, Pearson Education Asia
2. "Network Security private communication in a public world", C. Kaufman, R. Perlman and M. Speciner, Pearson
3. Cryptography & Network Security: Atul Kahate, TMH.
4. "Network Security Essentials: Applications and Standards" by William Stallings, Pearson
5. "Designing Network Security", Merike Kaeo, 2nd Edition, Pearson Books
6. "Building Internet Firewalls", Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2nd Edition, Oreilly
7. "Practical Unix & Internet Security", Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Course Name: SOFT COMPUTING APPLICATIONS					
Course Code: INFO4282					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

<u>After successfully completing this course the students will be able to:</u>

1) Identify the Intractable problems like NP – complete, NP- hard problems and reproduce the optimal solution instead Optimum.
2) Determine the complexity of computation and reduce the complexity to interpret the real problems.
3) Assemble different techniques to sketch a hybrid system for better result.
4) Able to interpret the problem in terms time and space.
5) Justify the optimal solution and able to predict the running time of the program.

<u>Detailed Syllabus:</u>

Module-I: [8L]

Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing.

Genetic algorithm: Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross-over & mutation operator, Schema Theorem, Multi-objective Genetic Algorithm (MOGA).

Applications of Genetic Algorithm: genetic algorithms in search and optimization

Module-II: [8L]

Fuzzy sets and Fuzzy logic systems: Classical Sets, Fuzzy Sets and Fuzzy relations: Properties and operations on Classical sets, Fuzzy set and fuzzy relations.

Membership functions: Features of membership functions, standard forms and boundaries, different fuzzification methods.

Fuzzy to Crisp conversions: Lambda Cuts for fuzzy sets, fuzzy Relations, De-fuzzification methods.

Module-III: [9L]

Classical Logic and Fuzzy Logic: Classical predicate logic, Fuzzy Logic, Approximate reasoning and Fuzzy Implication

Applications of Fuzzy Logic: How Fuzzy Logic is applied in Home Appliances

Neural Network: Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference between ANN and human brain, characteristics and applications of ANN, single layer network, Perceptron training algorithm, Linear separability, Hebb's learning rule/Delta rule, ADALINE, MADALINE

Module-IV: [9L]

Introduction of MLP: Different activation functions, Error back propagation algorithm, derivation of BBPA, momentum, limitation, characteristics and application of EBPA, Hopfield/ Recurrent network, configuration, stability constraints, XOR network.

Adaptive Resonance Theory: Architecture, classifications, Implementation and training.

Applications of Neural Networks: Pattern Recognition and classification

References:

1. Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.
2. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI
3. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg
4. Neural Networks: A Comprehensive Foundation (2nd Edition), Simon Haykin, Prentice Hall.

Prof. (Dr.) Siuli Roy
Head, Dept. of Information Technology
Heritage Institute of Technology

Industry Competence Laboratory [INFO4121]

Course Outcome:

After successfully completing this course the students will be able to:

1) Recall Knowledge in Programming language, Software Engineering and Web based software technologies includes JSP/Servelet, PHP, ASP.Net, C#, VB.net , MySQL, SQL Server, Oracle .
2) Describe the problem statement in the form of project, express it with different s/w engineering tools (ERD, DFD, UML diagram using MS Visio/DIA) . Also give example which is related to industry project or prototype of industry project.
3) Apply S/W engineering tools (ERD, DFD, UML diagram using MS Visio/ DIA) and S/W (JSP/Servelet, PHP, ASP.Net, C#, VB.net) and database (MySQL, SQL Server, Oracle) to develop the application program to build the project. The developed project is applied in real life scenarios.
4) Break-down the project using Software Development Life Cycle (SDLC) concept to build efficiently.
5) Diagram the project for pictorial representation using s/w engineering tools (ERD, DFD, UML diagram using MS Visio/DIA).
6) Diagnose the faults or errors on going through the Software Development Life Cycle (SDLC) also diagnose the errors in application software developed for the project.

Industry Training Evaluation [INFO4131]

Course Outcome:

After successfully completing this course the students will be able to:

1) Getting acquainted with advanced tools and techniques, and apply it at appropriate levels.

2) Interact with industrial personnel and follow engineering practices and maintain work ethics and discipline required in the industry.

3) Acquire the experience about industry workplace behavior and develop team coordination skills.

4) Prepare professional work reports and enhance the skills of presentation before industry professionals.

5) Apply all the acquired knowledge and work dedicatedly in projects provided.

6) Apply ethical principles and learn to commit to responsibilities meeting deadlines provided.

PROJECT-I [INFO4191]

Course Outcome:

After successfully completing this course the students will be able to:

1. Recall knowledge of their selected project topic.
2. Identify the problem to solve.
3. Design the solution of the problem by using software/ hardware skills.
4. Apply modern Information Technology tools and techniques for implementing the solution.
5. Prepare report after implementing the project
6. Demonstrate the project work.

Comprehensive Viva Voce [INFO4231]

Course Outcome:

After successfully completing this course the students will be able to:

1) Able to get the opportunity to revise the subject knowledge acquired throughout the four years.

2) Provides the scope to focus more on the subject knowledge required for future competitive exams, specially exams required for higher studies.

3) Able to enhance the oral communication and presentation skills before the group of members in a panel.

4) Develop the confidence in presenting and answering the questions before the group of members in the panel.

5) Develop the skill of prompt answering within a limited/short time period.

6) Able to understand the state of individual self, with respect to the knowledge acquired and thereby change himself/herself, and dedicate more time to learn/revise the domain of weakness.

PROJECT-II [INFO4291]

Course Outcome:

After successfully completing this course the students will be able to:

1. Recall knowledge of their selected project topic.
2. Identify the problem to solve.
3. Design the solution of the problem by using software/ hardware skills.
4. Apply modern Information Technology tools and techniques for implementing the solution.
5. Prepare report after implementing the project
6. Demonstrate the project work.

Subject Name: Modeling Simulation and Optimization					
Paper Code: CHEN 4103					
Contact Hours PerWeek	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

1. Given an unit process, students will be able to apply fundamental engineering concepts andheuristics to simulate the process flowsheet.

2. Given a reactor networking problem, students will be able to draw the appropriate attainableregion and conclude about the reactor types needed.

3. Given a particular separation operation, students will be able to select the correct separation process and process equipment, and will be able to apply heuristics for choosing the correct operating methods for the equipment.

4. Given an optimization problem for a Chemical Engineering system, students will be able toanalyze the given system to mathematically formulate the complete optimization problem required.

5. Given an optimization problem for a Chemical Engineering system, students will be able to identify whether the problem requires linear or non-linear optimization techniques for solving.

6. Given an optimization problem for a Chemical Engineering system, students will be able toanalyze the optimization problem to apply the correct optimization method.

Module 1 : 10 L

Principles and methods of steady state flowsheet simulation, Principles and methods of of batch flowsheet simulation. Heuristics for process synthesis in : Distribution of Chemicals, Separations, Heat removal from and addition to reactors, Heat exchanges and furnaces; Optimal design of batch process units : design of reactor-separator process, design of single product process.

Module II : 10L

Reactor design and reactor network synthesis: Reactor Models for stoichiometry, extent of reaction, equilibrium, kinetics. Ideal kinetic reactor models for CSTR and PFR. Example Problems. Reactor design using the attainable region: construction of attainable region,principle of reaction invariant.

Module III : 10 L

Synthesis of separation trains: Criterion for selection of separation methods; selection of separation equipment for absorption, stripping and distillation, liquid-liquid extraction, membrane separation, adsorption, leaching, crystallization and drying; Sequencing of distillation column for the separation of nearly ideal fluid mixture; separation of systems for gas mixtures.

Module IV: 10 L

Optimization of Process flow sheet - General formulation of the optimization problem; Linear programming, Non-linear programming with a single variable ; Conditions for NLP with gradient method for two or more decision variables; Optimization algorithm ; Flowsheet optimization – case studies.

Text Books:

1. W. D. Sieder, J. D. Seader and D. R. Lewin, Product and Process Design Principles,John Wiley and Sons, 3rd edition, 2008

References:

1. H. Scott Fogler, Elements of Chemical Reaction Engineering, Prentice HallInternational. Series, 3rd Edition. 1999
2. J.D. Seader, Earnest J. Henley, D. Keith Roper, Separation Process Principles, 3rdEdition. 2013.
3. Thomas F. Edgar and David. M. Himmelblau, Optimization of Chemical Processes,
2. McGraw-Hill Higher Education; 2nd Edition. 2001.

Subject Name: Reactor Design					
Paper Code: CHEN 4141					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

1. Ability to develop a fundamental understanding of chemical reactor design
2. Ability to develop critical thinking skills on selection of chemical reactor.
3. Ability to develop creative thinking skills on design of two phase and three phase reactors.
4. Ability to use principles of chemical reaction engineering in designing suitable contactingdevice for reactions with heat effects.
5. Ability to analyze stability of mixed flow reactor employed for carrying out thermal reactions.
6. Ability to design bioreactors for both enzymatic and live cell catalyzed reactions.

Module I : 10L

General Requisites of the study: Stoichiometry, Rate equations, Effect of temperature on reaction rate by Arrhenius, Collision and Transition State Theory, Basic methods of Evaluation of kinetic parameters by differential, integral and half life methods with reference to Constant volume and variable volume problem.

Reactors: Types of reactors, Advantages and Disadvantages, Reactor Selection, Applications Homogeneous Reactor Design: Formulation of ideal reactor design equations for simple models of batch, mixed flow and plug flow reactors.

Module II : 10L

Combination of reactors of various types in either series or parallel operation Selection of proper contacting patterns for multiple reactions occurring in either series or parallel

Description of heterogeneous catalytic reactors, e.g. packed bed reactor, tubular reactor,mixed flow reactor, slurry reactor, trickle bed reactor.

Design of heterogeneous catalytic reactors: calculation of catalyst requirement, flow regimes, pressure drop. Design of Fluidized Bed Reactor.

Module III : 10L

Basic Principles applied in Bio Reactors – Enzyme Kinetics based upon Rapid Equilibriumand Quasi Steady State Assumptions, Evaluation of Kinetics parameters.

Design of bioreactors with emphasis on Cell growth kinetics, Substrate limited growth, the logistic equation, rate loss, stoichiometry, mass balances, design equations, numerical problems, wash out, oxygen limited fermentation, scale up concepts of bio-reactors, chemostat and its applications.

Module IV: 10L

Reactor Internals: component and use.

Evaluation of conversion in non ideal reactors from RTD study using experimental data and model equations. Introduction to non isothermal reactor design, Energy balance equations for batch and flow reactors, Evaluation of batch and flow reactor volumes for adiabatic reaction.

Reactor Safety and Runway Reaction

Text Books:

1. J.M, Smith, Chemical Engineering Kinetics, Mc-Graw Hill, 3rd Edition.
2. H. Scott Fogler , Elements of Chemical Reaction Engineering, Prentice Hall India, 4th Edition
3. Shuler, Michael L., Kargi, Fikret, Bioprocess Engineering, Pearson Education, 3rd Edition, (2015).

References:

1. O. Levenspiel, Chemical Reaction Engineering, Wiley Eastern Ltd., 2nd & 3rd Editions
2. J.B. Rawlings, J.G. Ekerdt, Chemical Reactor Analysis and Design Fundamentals, NobHill Publishing, 2nd Edition.
3. C.G. Hill, Introduction to Chemical Engineering Kinetics And Reactor Design, Wiley 1977
4. L.D. Schmidt, The Engineering of Chemical Reactions, Oxford University Press, 2nd Edition.

Subject Name: Industrial Safety and Hazard Analysis					
Paper Code: CHEN 4142					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

1. Ability to use important technical fundamentals of chemical process safety and to impart basic knowledge that allows the students to evaluate occupational safety and health hazards in the workplace.
2. Ability to determine hazard and potential hazard areas and to adopt appropriate hazard controls.
3. Ability to analyze the effects of workplace exposures, injuries and illnesses, fatalities
4. Ability to use safety programs to prevent or mitigate damage or losses and to developpreventative measure to avoid accident.
5. Ability to use logic based quantitative risk analysis.
6. Ability to carry out safety audits and to set up safe health management program.

Module I : 10L

Definition of safety, Hazard and Risk, Safety program, Engineering ethics, Inherent safety, Safety regulations, OSHA, Process safety management, Hazards due to fire, explosions and toxic chemicals, Distinction between fire and explosion, Upper Flammability limit and Lower Flammability Limit, Fire Triangle, BLEVE, Runaway reaction.

Module II : 10L

Tools for hazards identification: HAZOP, Fault Tree, Event Tree, FMEA, Dow Fire and Explosion Index, Mond Index.

Module III : 10L

Risk analysis concept and methodology: Risk concept and measure of risk, Risk acceptance criteria, Quantitative risk analysis, Probit number.

Module IV: 10L

Control of chemical plant hazards, Intensification and attenuation of hazardous materials, Industrial plant layout, Ventilation, Fire prevention, Personnel protection devices, Laboratory safety, Emergency safety, Safety systems and disaster management. Case studies, Flixborough (England), Bhopal (India), Seveso (Italy), Pasadona (Texas)

Text Book:

1. D.A. Crowl and J.F. Louvar, Chemical Process Safety: Fundamentals with Applications:, Prentice Hall, 1990

References:

1. O.P. Kharbanda, E. A Stallworthy, Safety in Chemical Process Industries: Heinmann
2. Professional Publishing LTD.1988
3. C.A. Wentz, Hazardous Waste management: Mc-Graw Hill, ISBN-13: 978-0070692916
4. S.L Cutter. Environmental Risks & Hazards, Prentice Hall,1994
5. Trevor A. Kletz, What went wrong? Case Histories of Process Plant Disasters andHow They Could Have Been Avoided,5th Edition, ISBN: 978-1-85617-531-9

Subject Name: Safety and Hazard Analysis					
Paper Code: CHEN 4181					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

1. Ability to understand and recognize the important technical fundamentals of chemical process safety and to impart basic knowledge that allows the students to evaluate occupational safety and health hazards in the workplace.
2. Ability to determine hazard and potential hazard areas and to adopt appropriate hazard controls.
3. Ability to analyze the effects of workplace exposures, injuries and illnesses, fatalities
4. Ability to use safety programs to prevent or mitigate damage or losses and to develop preventative measure to avoid accident.
5. Ability to understand and use logic based quantitative risk analysis.
6. Ability to carry out safety audits and to set up safe health management program.

Module I : 10 L

Definition of safety, Hazard and Risk, Safety program, Engineering ethics, Inherent safety, Safety regulations, OSHA, Process safety management, Hazards due to fire, explosions and toxic chemicals, Distinction between fire and explosion, Upper Flammability limit and Lower Flammability Limit, Fire Triangle, BLEVE, Runaway reaction.

Module II : 10 L

Tools for hazards identification: HAZOP, Fault Tree, Event Tree, FMEA, Dow Fire and Explosion Index, Mond Index. .

Module III : 10 L

Risk analysis concept and methodology: Risk concept and measure of risk, Risk acceptance criteria, Quantitative risk analysis, Probit number.

Module IV: 10L

Control of chemical plant hazards, Intensification and attenuation of hazardous materials, Industrial plant layout, Ventilation, Fire prevention, Personnel protection devices, Laboratory safety, Emergency safety, Safety systems and disaster management. Case studies, Flixborough (England), Bhopal (India), Seveso (Italy), Pasadona (Texas)

Text Books :

1. D.A Crowl and J. F Louvar Chemical Process Safety: Fundamentals with Applications:, Prentice Hall, 1990

References:

1. O.P. Kharbanda and Stallworthy E. A, Safety in Chemical Process Industries:, Heinmann
2. Professional Publishing LTD.,1988
3. C. A, Wentz Hazardous Waste management: Mc Graw-Hill, 1989.
4. S.L Cutter.Environmental Risks & Hazards, Prentice Hall,1994
5. Trevor A. Kletz, What went wrong? Case Histories of Process Plant Disasters and How They
6. Could Have Been Avoided,5th Edition, ISBN: 978-1-85617-531-9

Subject Name: Project Management					
Paper Code: CHEN 4182					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

1. Students will gather adequate basic and advanced knowledge on various aspects of project management covering planning, scheduling and successful execution of multifarious projects in all sectors.
2. Students will acquire enough professional skills for the preparation and appraisal of various projects in private and public sectors.
3. They are able to work with confidence and integrate multidisciplinary project team effectively.
4. They are capable to identify useful projects for investment and can start their own enterprise as career.
5. They are able to evaluate the technical feasibility and commercial viability of any project.
6. To establish themselves as potential project consultants for proper guidance and valuable services to present and future investors.

Module I : 10L

Project Management Fundamentals: Definition of a Project, Project Management, Scope Management, Program Management, Portfolio Management, Stakeholder Management: Identify Stakeholders, Plan Stakeholder Management; Manage Stakeholder Engagement, Control Stakeholder Engagement, Organization Structure; Project Lifecycle vs. Product Lifecycle; Feasibility Analysis; Project Evaluation Techniques; Summary Illustrative Review Problems / Incidents.

Module II : 10L

Project Network Techniques: PERT/CPM; Project Planning & Scheduling; Project Work Breakdown Structure & networking; Project Network Techniques PERT / CPM, Time & Cost based calculations using PERT, Scheduling Projects, Resourcing Projects, Budgeting Projects, Project Risk Planning, Project Quality Planning and Project Kickoff, Summary Illustrative Review Problems / Incidents.

Module III : 10L

Planning Projects: Stakeholder Analysis and Communication; Planning & Defining Scope, Capital Estimates, Investment Analysis and Justification; Project scheduling with unlimited Resources, Project scheduling with limited Resources, Risk Management: Planning Risk

Management, Risk Identification, Qualitative & Quantitative Risk Analysis, Planning Risk Responses; Risks Control; Summary Illustrative Review Problems / Incidents.

Module IV: 10L

Project Resource Allocation: Project Human Resource, Procurement & Materials Management; Project Organization Structure, Leadership Style, Effective Project Teams, Managing Conflicts; Project Total Quality Management, Project Contract Management, Project Procurement & Materials Management, Computer Based Project Management, Project Management using MS Project & Prinavera, Software Project Management, Project Monitoring & Control, Project Case Study Project Integration Management; Summary Illustrative Review Problems / Incidents.

Text Books:

1. M. Peter, K. Timmerhaus, R. West, Plant Design and economics for Chemical Engineers, McGraw-Hill Science/Engineering/Math, 5th Edition,2002.
2. 2. K. Nagarajan, Project Management, 2nd edition, New Age International publisher, 01-Jan- 2004, ISBN: 81-224-1557-1
3. Eugene Grant and Richard Leavenworth, Statistical Quality Control, 6th Edition, publisher: McGraw-Hill 1996.

Reference:

1. R. K. Sinnott, Coulson and Richardson's Chemical Engineering, Volume 6, Second Edition: Chemical Engineering Design (Chemical Engineering Technical Series), 2nd Edition, Pergamon,1993.
2. P.C.Jain, Handbook for new entrepreneur, Oxford University Press, 2012.
3. V.G. Patel, The Seven-Business Crisis. How to beat them? Tata McGraw-Hill Co. Ltd, 1995.
4. Daniel Goleman, Working with emotional intelligence; Butam Books, 2000.
5. John Happel, Donald G. Jordan, Chemical process economics, 2nd Edition, Marcel Dekker, Inc., New York, 1976.
6. Ernest E. Ludwig, Applied project management for the process industries, Gulf Pub. Co. 1974.
7. Jack R. Meredith, Samuel J. Mantel, Jr., Scott M. Shafer, “Project Management: A Managerial Approach”, 9th Edition International, Student Version, February 2015, ©2014.
8. Russell Darnall and John M. Preston, Project Management: from Simple to Complex, ©2016 Flat World Education, Inc. v. 1.0,Version: 1.0, Pub Date: May 2010, eISBN: 978-1-4533- 2704-3.

Subject Name: Catalysis & Catalytic Reactor Design					
Paper Code: CHEN 4241					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:
1. Ability to develop a fundamental understanding of chemical reactor design
2. Ability to develop critical thinking skills on selection of suitable chemical reactor.
3. Ability to develop creative thinking skills on design of multiphase reactors.
4. Ability to apply reaction kinetics principles in chemical and biochemical reaction engineering.
5. Ability to identify and formulate problems in chemical and biochemical reaction engineering and find appropriate solutions.
6. Ability to design bioreactors for both enzymatic and live cell catalyzed reactions.

Module I : 10L

Introduction to homogeneous and heterogeneous catalysis, Factors affecting heterogeneous catalytic reaction; Methods for finding rates- Integral Analysis, Differential Analysis
Types of catalytic Reactor- Differential Reactor, Integral Reactor and their performance equations.
Pore diffusion resistance combined with surface Kinetics. Concept of Thiele modulus and Weisz modulus, Concept of effectiveness factor.

Module II : 10L

External mass and heat transfer in catalyst particles. Design of Packed bed reactor, fluidized bed reactor, Basket type reactor. Description of slurry reactor; Trickle bed reactor.
Diferent steps in a catalytic reaction, Langmuir adsorption isotherm
Catalysis mechanism; Langmuir-Hinshelwood mechanisms, Eley –Rideal mechanisms
Enzyme kinetics: Michaelis and Menten equation, Briggs Halden equation, numerical problems on enzymatic reactions

Module III : 10L

Determination of Catalyst surface area and particle size; Brunauer, Emmett, Teller (BET) equation, Concept of void volume and solid density-Helium mercury method. Pore volume Distribution-mercury penetration method, Nitrogen desorption method.
General methods for preparation of catalysts: precipitation, sol-gel, mixing components with water milling, impregnation, Concept of Promoter & Inhibitor;

Module IV: 10L

Catalyst Deactivation: Fouling and poisoning; Mechanisms of Catalyst Deactivation, Rate equation, activity of catalyst, Parallel deactivation, Series deactivation, Side by side deactivation, independent deactivation.

Biocatalyst and Bioreactor Design:

Cell growth kinetics, Substrate limited growth, the logistic equation, rate loss, stoichiometry, mass balances, design equations, numerical problems, oxygen limited fermentation, scale up concepts of bio-reactors, chemostat and its applications, Wash Out, continuous culture devices, case studies on penicillin production.

Text Books

1. O. Levenspiel, Chemical Reaction Engineering; 3rd. ed. Wiley Eastern Ltd.1998
2. H. Fogler, Elements of Chemical Reaction Engineering, 4th. Ed. Prentice Hall of India, 2005
3. J.M. Smith, Chemical Engineering Kinetics, 3rd.ed. McGraw Hill.1981

References:

1. James J Carberry, Chemical and catalytic reaction engineering, McGraw Hill.2001
2. G.F Froment., K.B Bischoff, Chemical Reactor Analysis and design-.; John Wiley & Sons.1979
3. Lanny D Schmidt, The Engineering of Chemical Reactions-; Oxford University Press.2004

Subject Name: Total Quality Management					
Paper Code: CHEN 4242					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

1. The students will learn the appriate meaning and interpretation the term Quality and the significance of Quality Management in the organisation and outside the organisation i.e, Total Quality management
2. The students will be able to identify and control the quality of processes and hence that of products or goods & services by applying basic statistical tools like Process control charts, Pareto analysis, bar-chart/histogram, checklist preparations, Fish-bone diagramin etc the processes.
3. The students will learn and apply evaluate the process capabilities of different processes in any business process or industry and apply modern quality management like Six Sigma technique and implementation of quality system etc
4. The students will be able learn various sampling techniques and develop different sampling plans respectively to evaluate the quality of various types of defects like measurable and countable in products both in-house and vendor's house for warranting the quality of products.
5. The students will be able to prepare network of activities involved in project for plant design or other business processes and critically examine the schedule for the completion of the project and cost impacts for the project.
6. The students will be able to carry out the final feasibility study and and economic assessment for the design of a new plant or expanding an existing business by taking recourse to critical path method or project eavaluation & review technique for reporting the success of the project.

Module I : 10L

Basic concepts– Three paradigms of management and evolution of concept of quality management, Organization: its basic objectives and goal, Mission and Vision, customer and secondary customer, Deming’s wheel, bottom line: profit vs quality, historical defilements: Juran, Deming, Ischikawa and Taguchi, Kaizen, JIT. Basic statistical concepts associated with quality management, measurement of central tendency and dispersion, range versus variance, quality and process capability, probability distributions, concept of statistical quality control.

Module II : 10L

Use of control charts and process engineering techniques for implementing the quality plan: X—R chart, moving average chart, p-chart, c-chart and control chart for continuous

production Acceptance sampling: single–double and multiple sampling, AOQ, AQL, LTPD, Chain sampling plan, Dodge-Romig plan.

Module III : 10L

Tools and techniques for improvement in TQM: type A techniques with a special reference to FPC & FD, QFD, SWOT analysis; type B techniques with a special reference to brainstorming, stratification, Ischikawa diagram, check sheet, Pareto diagram Philosophy and concept of quality circle: formation, steering committee, power and functions of leader, dy. Leader, coordinator, facilitator, case studies.

Module IV: 10L

Different standards: ISO, BS and Bureau of Indian Standards, details of ISO 9000 series, ISO 14000 series and SA 8000 and the certification authorities, productivity control management.

Text Books:

1. Statistical Quality Control, 6th Edition, by Eugene Grant and Richard Leavenworth,Mc-Graw Hill. 1996

References:

1. H. Lal Total Quality Management- A Practical Approach (1st Edition): NewAge International, 1990
2. S R Udpa, Quality Circle 1981.
3. S. M. Sundararaju, Total Quality Management – A Primer: S. M. Sundararaju, TataMc- Graw Hill.
4. 4. Amitava Mitra Fundamentals of Quality Control and Improvement, 2nd Edition.;Prentice- Hall of India, 1998.

4. Subburaj Ramasamy, Total Quality management, Mc-Graw Hill Education (India)Pvt. Ltd, 2012.

Subject Name: Total Quality Management &Assurance					
Paper Code: CHEN 4282					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

1. The students will learn the appriate meaning and interpretation the term Quality and the significance of Quality Management in the organisation and outside the organisation i.e, Total Quality management
2. The students will be able to identify and control the quality of processes and hence that of products or goods & services by applying basic statistical tools like Process control charts, Pareto analysis, bar-chart/histogram, checklist preparations, Fish-bone diagramin etc the processes.
3. The students will learn and apply evaluate the process capabilities of different processes in any business process or industry and apply modern quality management like Six Sigma technique and implementation of quality system etc
4. The students will be able learn various sampling techniques and develop different sampling plans respectively to evaluate the quality of various types of defects like measurable and countable in products both in-house and vendor's house for warranting the quality of products.
5. The students will be able to prepare network of activities involved in project for plant design or other business processes and critically examine the schedule for the completion of the project and cost impacts for the project.
6. The students will be able to carry out the final feasibility study and and economic assessment for the design of a new plant or expanding an existing business by taking recourse to critical path method or project eavaluation & review technique for reporting the success of the project.

Module I : 10L

Basic concepts–Organization: its basic objectives and goal, Mission and Vision, customer and secondary customer, Bottom line: profit vs quality, Basic statistical concepts associated with quality management, measurement of central tendency and dispersion, range versus variance, quality and process capability, probability distributions, concept of statistical quality control.

Module II : 10L

Case Studies: Use of control charts and process engineering techniques for implementing the continuous production. Case Studies: Acceptance sampling: single–double and multiple sampling, AOQ, AQL, LTPD, Chain sampling plan, Dodge-Romig plan.

Module III : 10L

Tools and techniques for improvement in TQM: type A techniques with a special reference to FPC & FD, QFD, SWOT analysis; type B techniques with a special reference to brainstorming, stratification, Ischikawa diagram, check sheet, Pareto diagram Philosophy andconcept of quality circle: formation, steering committee, power and functions of leader, dy. Leader, coordinator, facilitator, case studies.

Module IV: 10L

Six Sigma: philosophy and concepts, Case Studies: Six Sigma implementation in business process, service sector & manufacturing industry.

Implementation methodologies of Different standards: ISO, BS and Bureau of Indian Standards, details of ISO 9000 series, ISO 14000 series and SA 8000 and the certification authorities, productivity control management.

Text Books:

1. Statistical Quality Control, 6th Edition, by Eugene Grant and Richard Leavenworth,Mc-Graw Hill. 1996

References:

1. H. Lal .,Total Quality Management- A Practical Approach (1st Edition): NewAge International, 1990
2. S R Udpa Quality Circle:, 1981.
3. S. M. Sudarraju Total Quality Management – A Primer:, Tata Mc-Graw Hill, 2001.
4. 4. Amitava Mitra, Fundamentals of Quality Control and Improvement, 2nd Edition.;Prentice- Hall of India, 1998,
5. Subburaj Ramasamy, Total Quality management;, Mc.Graw Hill Education (India)Pvt. Ltd, 2012.

Subject Name: Industrial Training					
Paper Code: CHEN 4131					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	-	**-**	**-**	**-**	**2**

Students sent for Industrial Training during Summer Recess after 6th Semester for a minimum duration of four weeks will submit two copies of Training Report (only Hard /Spiral bound is allowed) on or before a notified date, to the Faculty In-charge, In-plant Training. The Viva voce would be held before commencement of Practical Examination. Report should consist of:

1. Copy of Training Certificate & allotment order (if any)
2. A general overview of the Plant.
3. The products and raw material sources of the Plant.
4. Process description/flow diagram of individual units
5. Environment & Safety Aspects, Techno-economics /Corporate Social Responsibility work of the organization if any.
6. For Training in R & D organizations/project Work, overview of work with sketches, Objectives, Materials & Methods, Result & Discussions are to be included instead of items mentioned in points 2-5.

Subject Name: Seminar II					
Paper Code: CHEN 4132					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**0**	**3**	**2**

A Seminar topic will be allotted to individual student according to his/her subject of interest. A thorough report should be prepared based on which seminar presentation and question- answer session will be conducted. Assessment of the student would be done by the faculty members on the basis of presentation, performance in the question - answer session and the report submitted, giving equal weightage on each component.

Seminar Courses will enable the student to carry out independent review of existing and novel developments in Chemical Engineering Science. The courses will also enable them to develop presentation and communication skills.

Subject Name: Plant Design					
Paper Code: CHEN 4221					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**4**

Each student shall be required to prepare a report on a topic of design under the supervision of a faculty. The design problem has to be solved by the student himself occasionally consulting his supervisor. The design problem shall be allotted to the student at the beginning of the eighth semester. The report in duplicate has to be submitted in typed and bound form one week before the commencement of the 8^{th} (final) semester examination.
The examination shall include oral presentation of the design report and a viva-voce. Equal weightage shall be given on oral presentation and viva-voce.

This course will enable the student to apply the concepts learnt in previous semesters, to select among different alternative technologies, and finally to develop presentation skills.

ECE, B.Tech. Final year Syllabus, 1st. Semester

Course Name : RF & MICROWAVE ENGINEERING					
Course Code : ECEN 4101					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course outcomes:
After completing this course, the students will be able to:

1. Apply previous E.M. theory concepts to understand microwave engineering.
2. Identify high frequency electromagnetic wave propagation characteristics through guided media.
3. Analyze microwave passive components and circuits.
4. Students should be able to enhance their knowledge on semiconductor and vacuum tube devices operating at high frequency.
5. Design high frequency filters and amplifiers.
6. Implement the concepts in developing different prototype microwave systems.

Module	Topics	Hours
1	**Introduction** RF & Microwave Spectrum, Typical applications of RF and Microwave Engineering, Safety considerations	1
	Waveguides and Resonators Rectangular waveguides, TE & TM modes, TE_{10} mode analysis, cut-off frequency, propagation constant, intrinsic wave impedance, phase and group velocity, Power transmission, attenuation, waveguide excitation, wall current; Introduction of circular waveguide; Rectangular waveguide resonator- Design consideration, resonant frequency, Q-factor, excitation. Circular waveguides, TE_{11} mode analysis. Rectangular waveguide resonator- Design consideration, resonant frequency, Q-factor, excitation.	8
	Planar Transmission Lines Micro-strip lines, Coplanar waveguide, Slot line-design consideration, field patterns, propagation characteristics, Comparison for different characteristics of the above mentioned lines.	2
2	**Waveguide Passive Components and their S-matrix Representation** N-port networks-Properties of S matrix, Transmission matrix & their relationships; Microwave passive components and their S matrix representation: Attenuators, Phase shifter, Directional coupler, Bethe-hole coupler, Two hole coupler, Magic tee, hybrid ring, Circulators, Isolators	7
	Impedance Matching Networks Stub matching, Quarter wave matching, Introduction to theory of Small Reflections and tapered lines.	4

HOD, ECE Department
Heritage Institute of Technology
Kolkata

3	**Microwave Tubes** Electron beam & Field interaction for energy exchange in resonant (two cavity klystron, Reflex Klystron, Magnetron) and TWT microwave active devices: Typical characteristics &applications (only physical explanation is required, no mathematical derivation required).	5
	Semiconductor Microwave devices TED (Gunn diode) & Avalanche Transit Time (IMPATT) device, Schottky diode, PIN diode characteristics & applications; Microwave bipolar transistor, Microwave field effect transistor (MESFET)	4
4	**Microwave Filter Design** Design procedure of filter design using insertion loss method (maximally flat and equi-ripple), low pass prototype design, conversion to other filter prototypes.	5
	Microwave Amplifier Design Basic consideration in the design of RF amplifier- Transistor S-parameter, Stability, matching network, noise figure; Matching network design using lumped elements and L-Section. Brief introduction to NBA, LNA	6

Text books:

1. Microwave Engineering, 3rd edition David M. Pozar, Wiley & Sons Inc.
2. Microwave Engineering, Monojit Mitra, Dhanpat Rai & Co.
3. Microwave Engineering, A Das & S Das, TMH.
4. Microwave Devices & Circuits, SY Liao , Pearson Education /PHI
5. Microwave Engineering Fundamentals, Design and Applications, Subal Kar, University Press

HOD, ECE Department
Heritage Institute of Technology
Kolkata

References:

6. Microwave Engineering-Passive Circuits, PA Rizzi , Pearson Education.
7. Microwaves, K C Gupta, New Age Publishers.
8. Foundation of Microwave Engineering, 2ed edition, Robert E Collin, McGraw Hill, Inc.
9. Microwave Devices & Circuit Design , GP Srivastava & VL Gupta, PHI
10. Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design, M. Radmanesh, Authorhouse

Course Name : RF & MICROWAVE ENGINEERING LABORATORY					
Course Code : ECEN 4111					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**2**

COURSE OUTCOME:

After completing the following experiments, students will be able to:

HOD, ECE Department
Heritage Institute of Technology
Kolkata

1. Understand electromagnetic wave propagation at high frequency.
2. Identify the difference between active and passive microwave devices.
3. Analyze and Characterize Microwave Devices.
4. Design measurement setup to perform analysis of microwave devices.

List of Experiments:

1. Determination of phase and group velocities in a waveguide carrying TE10 Wave from Dispersion diagram [ω-β Plot].
2. Measurement of unknown impedance using shift in minima technique using a waveguide test bench/ Measurement of the susceptance of an inductive and or a capacitive window using shift in minima technique using a waveguide test bench
3. Study of the characteristics of a Reflex Klystron oscillator
4. Study of Gunn Diode Characteristics using X-band waveguide test bench
5. Study of a Microwave Filters (LPF/BPF/HPF) using waveguide test bench.
6. Scattering matrix of a magic tee / E-plane tee / H-plane tee using waveguide test bench at X-band.
7. Measurement of Coupling factor, Directivity, Insertion loss and Isolation of a Directional coupler using X-band waveguide test bench set up.
8. Measurement of dielectric constant of a material using waveguide test bench at X-band.

Reference Books:

1. ML Sisodia & GS Raghuvanshi Basic Microwave Techniques and Laboratory Manual; Wiley Eastern Limited 1987
2. EL Gintzton Microwave Measurements, McGraw-Hill Book Co.
3. M Sucher and J Fox, Handbook of Microwave Measurements, Vol I, Wiley-Interscience Inc.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name: CODING & INFORMATION THEORY					
Course Code: ECEN 4102					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:
After completing this course, the students will be able to:

1. Apply the concept of probability and estimate entropy, mutual information and channel capacity.
2. Design different source codes and measure efficiency and redundancy.
3. Use the concept of mathematics and Boolean algebra, to analyze different error detection and correction mechanism.
4. Formulate encoding and decoding technique of linear block code.
5. Construct cyclic code to detect and correct error efficiently.
6. List the concept of BCH code using linear algebra and construct the convolution code encoder and importance of Viterbi decoding.

1. Information theory, Source coding and channels [10L]
Uncertainty and information, measure of information, average, mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes, Shanon- Fano coding.
Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.

2. Linear Block Codes [7L]
Matrix description of linear block codes, parity check matrix, decoding of a linear block code, Syndrome and Error detection, Minimum distance,Error detecting and Error-correcting capabilities, Standard Array , equivalent codes, perfect codes, Hamming codes.

3. Cyclic and Convolutional Codes [10L]
Code Polynomials, Generator Polynomials, Division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes,Decoding of cyclic codes.Golay codes, LFSR.
Tree codes, Trellis codes, Polynomial description of convolutional codes, Distance notions for convolutional codes, the generating function, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding.

4. Linear Algebra and BCH code: [11L]
Introduction to Linear Algebra, Introduction to Galois Field, Primitive elements, generator polynomials in terms of minimal polynomials, Calculation of minimal polynomial.
Elementary concept of BCH Codes, Encoding and Decoding, Elementary concept of Reed Solomon Code

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Books :

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Information and Coding - N Abramson; McGraw Hill.
3. Introduction to Information Theory - M Mansurpur; McGraw Hill.
4. Information Theory - R B Ash; Prentice Hall. 8. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.
5. Introduction to Error Control Codes – S Gravano; Oxford Press

Course Name : ADVANCED COMMUNICATION SYSTEMS					
Course Code : ECEN 4103					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcome:
After completing this course, the students will be able to:

1. The students will learn about the evolution of radio communication.
2. They will be able to appreciate the challenges of RF communication.
3. Different wireless networks and their operations will be clear to them.
4. The students will learn about the new technologies like SDR and Cognitive radios.
5. They will be able to understand the functioning of WI-FI networks.
6. Our students will be able to take up research work in communication domain.

MODULE – I:

Cellular Mobile Wireless Networks: Systems and Design Fundamentals:

Brief introduction to mobile wireless communication and systems, Description of cellular system, Cellular Structure, Frequency Reuse, Cell clustering, Capacity enhancement techniques for cellular networks, cell splitting, antenna sectoring, Co-channel and Adjacent channel interferences, Channel assignment schemes, mobility management, location management and handoff management. (6L)

Characteristics of wireless channel and propagation path loss models:
Fading, different types of fading, Inter symbol interference, fast fading model, Doppler effect due to velocity of mobiles, Rayleigh envelop, free space propagation model, two ray ground reflection model, log distance path loss model, log normal shadowing model, types of base stations and mobile station antennas. (4L)

MODULE – II:

Modern Mobile Wireless Communication Systems:

Evolution strategies – First Generation (1G) to Fourth Generation (4G), Introduction to SDR, Introduction to CR. (3L)

Multiple Access Technologies in cellular communication
Time division multiple access (TDMA), variants like narrowband and wideband TDMA, Frequency division multiple access (FDMA), Code Division Multiple Access (CDMA), Direct-sequence CDMA, spread spectrum technique, spectral efficiency of different wireless access technologies. (3L)
Cellular Communication Networks and Systems
Second generation (2G) Network: Global system for mobile communication (GSM): Architecture and Protocols, Air Interface, GSM spectrum, GSM Multiple Access Scheme, GSM Channel Organization, Traffic Channel multi-frame, Control (Signalling) Channel Multi-frame, Frames, Multi-frames, Super-frames and Hyper-frames, GSM Call Set up Procedure, Location Update Procedure, Routing of a call. (3L)
The concept of Packet data Services : 2.5G General Packet Radio Services GPRS network architecture, GPRS interfaces and reference points, GPRS Mobility management procedures,GPRS attachment and detachment procedures (3L)

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Overview of CDMA systems: IS-95 Networks and 3G – Th e Universal Mobile Telecommunication System (UMTS) CDMA based IS-95 Systems, forward link and reverse link for IS-95, handoff process in CDMA based IS-95 network. UMTS Network Architecture –Release 99, UMTS Interfaces, UMTS Network Evolution, UMTS FDD and TDD, UMTS Channels, Logical Channels, UMTS Time Slots (3L)

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module III:

Wireless Local Area Networks (WLAN): IEEE 802.11 Standards and Protocols

IEEE 802.11 standards, WLAN family, WLAN transmission technology, WLAN system architecture, Collision Sense Multiple Access with Collision Detection (CSMA/CD) and CSMA collision avoidance (CSMA/CA), Frequency Hopping Spread Spectra, 802.11 PHY and MAC layers, IEEE 802.11 Distributed Coordination function (DCF) and Point coordination function (PCF), Back off algorithm. (4L)

Wireless Broadband Networks and Access:

Evolution of broadband wireless, IEEE 802.16 standards : **WiMAX ,** Spectrum Allocation, IEEE 802.16 Standard Architecture, Overview of WiMAX PHY, IEEE 802.16 MAC Layer, IEEE 802.16, Orthogonal Frequency Division Multiple Access (OFDMA) (3L)

MODULE – IV:

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Mobile Internet Protocol

Basic Mobile IP, Mobile IP Type-MIPV4 and MIPv6, Mobile IP: Concept, Four basic entities for MIPv4, Mobile IPv4 Operations, Registration, Tunneling, MIPv4 Reverse Tunneling, MIPv4 Triangular Routing, Configuring PDP Addresses on Mobile Station, Mobility Classification, Seamless Terminal Mobility Management, Limitations of current TCP/IP networks for mobility support, Mobility solution. (4L)

Text books:

1. Wireless Networks: Applications and Protocols, T.S. Rappaport, Pearson Education
2. Wireless Communication and Networks : 3G and Beyond, I.Saha Misra, TMH Education.
3. Wireless Communications : Principles and Practice, T.S.Rappaport, PHI Learning.
4. Wireless Communications, A. Goldsmith, Cambridge University Press.
5. Mobile Communication Engineering W.C.R Lee (TMH)

Reference books:

1. Wireless Digital Communications: Modulations and Spread Spectrum Applications, K. Feher, Prentice Hall.
2. Wireless Communications and Networking, J.W.Mark and W. Zhuang, PHI.

Course Name : ADVANCED COMMUNICATION SYSTEMS LABORATORY					
Course Code : ECEN 4113					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	2	2

Course Outcomes:

After completing the following experiments, students will be able to:

1. Correlate different theories of wireless communication and fiber optics with practical experiments
2.Understand operations of repeater station, GPS and GSM cellular systems
3. Sort procedures for testing radio parameters
4.Learn working of fiber optic links

List of Experiments:

1. Study of working of Repeater stations with the help of Satellite communication system
2. Study of Global system for Mobile (GSM) system along with waveforms of different timing signals
3. Study of Global Positioning System (GPS) and plotting of active satellites with SNR etc.
4. Measurement of some important receiver parameters of a radio receiver like: i) SNR ; ii) Distortion with ISM band radio.
5. Measurement of some important transmitter parameters of a radio receiver like: VSWR for i) different antennae and ii) at different frequencies with ISM band radio.
6. Measurement of propagation loss, bending loss and connector loss in an optical fiber
7. Study of LASER characteristics
8. Measurement of wavelength of an optical fiber source
9. Study of a fiber optic analog link, study of PAM
10. Study of Frequency Division Multiplexing (FDM) and De multiplexing
11. Study of a fiber optic data link and study of TDM
12. Measurement of numerical aperture of an optical fiber

At least, 8 experiments are to be carried out in the semester.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

FREE ELECTIVES (Offered by ECE department) IN THE FIRST SEMESTER:

Course Name: VLSI DESIGN AUTOMATION					
Course Code : ECEN 4181					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
After completing this course, the students will be able to:

1. Relate to different MOS structures and functions in order to apply the knowledge in building CMOS circuits.
2. Determine logic and performance of CMOS combinational as well as sequential logic and apply the lambda based design rules.
3. Construct physical layout design and stick diagram of digital gates.
4. Classify between VLSI design cycle, style and methodology and also build various stages of miniaturization.
5. Make use of various synthesis flow and HDL modeling in ASIC semi custom design.
6. Build different logical synthesis algorithm and also differentiate between different physical design automation algorithms.

Module I: VLSI Circuits & Physical Layout: [12L]

Unit1: MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop

Unit2: CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm, Layout Legging.

Module II: VLSI Design Methodology: [8L]

Unit1: Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node,

Unit2: Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX, VLSI Design Cycle, Y-Chart.

Module III: EDA Tools: High level Synthesis and HDL: [8L]

Unit1: High level Synthesis EDA Flow, Control and Data Flow Graph, Scheduling, Allocation, Binding, RTL

Unit2: Why HDL ? Frontend Design Flow using HDL (Behavioral, RTL and Gate Level), Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed, Test Bench, FSM Example: Mealy Machine and Moore Machine. Pipeline Example.

Module IV: EDA Tools: Logical Synthesis and Physical Design Automation: [12L]

Unit1: Combinational Logic Optimization: BDD: Binary Decision Diagram, OBDD, ROBDD, and Technology Mapping: Pattern DAG, Subject DAG, Sequential Logic Optimization

Unit2: Physical Layout Automation EDA Flow, Partitioning: KL Algorithm, Floor-planning cost function, Placement, Detailed Routing: Channel Routing, Horizontal Constraint

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Graph, Vertical Constraint Graph, Cyclic Constraint, Left-edge Algorithm, Global Routing: Steiner Tree, Maze Routing.

Text Book:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000
2. Algorithms for VLSI Physical Design Automation, Author: N. Sherwani, KLUWER ACADEMIC PUBLISHERS (3rd edition)

Reference Book:

1. CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006
2. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011
3. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
4. VLSI Design and EDA TOOLS, Author: Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, SCITECH PUBLICATIONS (India) Pvt. Ltd., 2011
5. Algorithms for VLSI Design Automation, Author: Gerez, Wiley, 2011

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name :PRINCIPLES OF COMMUNICATION SYSTEMS					
Course Code : ECEN4183					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:
After completing this course, the students will be able to:

1. Apply the previous knowledge of analog communication and telecommunication systems to appreciate the contents of this subject.
2. Understand concepts of BB transmission, various modulation schemes sampling theorem and multiplexing schemes.
3. Identify concepts of Digital Transmission like PCM, Quantization, NRZ/RZ , noise Immunity etc.
4. Describe bit rate and baud rate of different signals and evaluate merits and demerits of different digital modulation techniques.
5. List the features of FSK,FSK,PSK,DPSK etc.
6. Categorize the concepts of Information Theory and Coding in terms of Entropy, Mutual Information, Shanon-Fano algorithm , source Coding, Channel coding etc.

Module - 1:
Elements of Communication system, Analog Modulation & Demodulation, Analog-to-Digital Conversion. (Basic ideas in brief) [8L]
[Details: Introduction to Base Band transmission & Modulation (basic concept) **(1L);** Elements of Communication systems (mention of transmitter, receiver and channel);**;** Basic principles of Linear Modulation (Amplitude Modulation) **(2L);** Basic principles of Non-linear modulation (Angle Modulation - FM, PM) **(2L);** Sampling theorem, Sampling rate, Reconstruction from samples, Aliasing **(1L);** Analog Pulse Modulation - PAM,PWM, PPM **(2L);**Multiplexing - TDM, FDM **(1L);**]

Module - 2:
Digital Transmission: (8L)
[Details: Basic concept of Pulse Code Modulation, Block diagram of PCM **(1L),**Concept of Quantisation & Quantisation error, Uniform Quantiser **(2L);** Non-uniform Quantiser, companding (mention only) **(1L);** Line coding & properties, NRZ & RZ, AMI, Manchester coding**(2L);** ISI, Nyquist criterion for zero ISI, Eye pattern, **(2L);**

Module - 3:
Digital Carrier Modulation & Demodulation Techniques: [7]
[Details: Introduction to the different digital modulation techniques - ASK, FSK, PSK, DPSK, QPSK **(5L);** Introduction to QAM **(1L);** Spread Spectrum Modulation - concept only. **(1L)**.

Module - 4:
Information Theory & Coding: [8]
[Details: Introduction, News value & Information content **(1L);**, Entropy **(1L);**, Mutual information **(1L);**, Information rate **(1L);**, Shanon-Fano algorithm for encoding **(1L);**, Shannon's Theorem - Source Coding Theorem **(1L);**, Channel Coding Theorem, Information

HOD, ECE Department
Heritage Institute of Technology
Kolklata

Capacity Theorem (basic understanding only) **(1L);**; Error Control & Coding - basic principle only. **(1L);**

Text Books:

1. An Introduction to Analog and Digital Communications by Simon Haykin; Published by Wiley India.
2. Data Communication and Networking by Behrouz A. Forouzan, Published by Tata McGraw-Hill

References:

1. Communication Systems 4th Edition by Simon Haykin; Published by Wiley India (Student Edition)
2. Principles and Analog and Digital Communication by Jerry D Gibson, Published by MacMillan.
3. Communication Systems by A. B. Carlson, Published by McGraw-Hill.
4. Understanding Signals and Systems by Jack Golten, Published by McGraw Hill.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name: REMOTE SENSING USING SATELLITES					
Course Code: ECEN4241					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:
After completing this course, the students will be able to:

1. Apply previously gathered knowledge on Electromagnetic Theory and Microwave Engineering to correlate design aspects of sensors aboard remote sensing satellites.
2. Identify the basic principles of Satellite Communication and its various application areas in remote sensing.
3. Categorize various parameters associated with remote sensing using satellites through the use of mathematical and logical tools to gain insight into the concept.
4. Understand the basics of remote sensing principles and technologies to acquireknowledge about the important applications for satellite remote sensing in research and the public and private sectors.
5. Gain knowledge about the various remote sensing techniques for applications in improving social, economic and environmental conditions for agricultural, forestry and water body management.
6. Categorize the role of the Indian space program in contrast to other space agencies worldwide for remote sensing applications.

Module 1: Introduction
Definition of Remote sensing ,Microwave Remote Sensing , Electromagnetic Radiation, Radiometric terms and definitions, Radiation Laws, EM spectrum, Sources of EM, Interaction of EM Radiation with atmosphere, and target, Atmospheric Widows, imaging spectrometry, Spectral signature of various land cover features (4L)
Features of Satellite communication systems in relation to other terrestrial systems. Satellite orbits, earth segment and space segment components. Modulation techniques used in satellite Communication. Satellite orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination (4L)

Module 2: Basics of Remote Sensing

Principles and concepts of Remote Sensing, Sources of energy, Active, passive, ground based and space based remote sensing techniques. Indian Remote sensing satellite systems. Major application of remote sensing in India. Concept of thematic mapping with remote sensed data. (4L)

Module 3: Remote Sensing Technologies

Satellite mounted remote sensors, spatial, spatial, radiometric and temporal resolution , field of View (FOV).Radiation principles (Plank's Law, Stephen Boltzman law)
Data Acquisition Platforms: Various types of platforms, different types of aircraft, manned and Unmanned spacecrafts used for data acquisition - characteristics of different types of platforms LANDSAT, SPOT, IRS, ERS, INSAT. Image analysis and interpretation-thermal imaging-image processing, classification and interpretation. Satellite sensors, detectors and scanning techniques. Radio Occultation (12L)

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module 4: Remote sensing systems

Weather forecasting radars, IR Radiometer Airborne and space borne radar, Satellite TTR (Telemetry, Telecommand and Ranging Stations) , LIDAR (light detection and ranging), Acoustic sounding systems, SODAR(Sonic detection and ranging) TRMM (Tropical rainfall measuring mission), AURA MLS, Megha Tropiques, Altimeter, Scatterometer, Radiometer, sea surface temperature, wind speed, water vapour and trace gas measuring systems. Generic software used for Remote sensing. Future trends and research areas (12L)

Total: 36 lectures

HOD, ECE Department
Heritage Institute of Technology
Kolklata

Books:
1. Remote Sensing & GIS – Basudeb Bhatta (Oxford University press)
2. Remote sensing of the environment : an earth resource perspective –John R Jenson(Pearson)
3. Satellite Communication System Engineering W.Pritchrd (Pearson)
4. Satellite Communication- Manojit Mitra PHI learning Pvt Ltd

Reference :
1. An Introduction to Remote Sensing And Its Applications: S.Somvansh & M.Kumari (S.K Kataria)
2. NASA'S Remote Sensing Tutorial http://rst.gsfc.nasa.gov/start.html
3. Satellite Communication: Maini & Agrawal (Wiley)

FREE ELECTIVES (Offered by ECE department) IN THE SECOND SEMESTER:

Course Name: CELLULAR & SATELLITE COMMUNICATION					
Course Code : ECEN 4281					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:
After completing this course, the students will be able to:

1. Apply the previous knowledge of analog and digital communication to appreciate the contents of this paper.
2. Understand elements of cellular network and its various parameters like freq. planning, cell structure etc.
3. Identify GSM and CDMA Cellular architecture and its various parameters.
4. Categorize different multiple access techniques used for Satellite Communication.
5. Understand various orbits, orbital parameters, satellite launch vehicles etc.
6. Design uplink and downlink for satellite networks.

Module I: [8L]

Brief introduction to mobile wireless communication and systems, Description of cellular system, Cellular Structure, Frequency Reuse, Cell clustering, Capacity enhancement techniques for cellular networks, cell splitting, antenna sectoring, Co-channel and Adjacent channel interferences, Channel assignment schemes – Fixed channel, Dynamic channel and Hybrid channel, mobility management – location management and handoff management, handoff process, different types of handoff.

Module II: [10L]

Evolution strategies – First Generation (1G) to Fourth Generation (4G), Personal Area Networks :PAN, Low Tier Wireless System: Cordless Telephone, Second Generation (CT2), Digital European Cordless Telecommunications (DECT), Public wide-area Wireless Networks: 1 G to 3G cellular networks (4L)

Second generation (2G) Network: Global system for mobile communication (GSM):Architecture and Protocols Air Interface, GSM spectrum, GSM Multiple Access Scheme, GSM Channel Organization (4L)

Overview of CDMA systems: IS-95 Networks and 3G – The Universal Mobile Telecommunication System (UMTS) CDMA based IS-95 Systems, forward link and reverse link for IS-95, handoff process in CDMA based IS 95 network (2L)

Module III: [8L]

Historical background, Basic concepts, Frequency allocation for satellite services, orbital & spacecraft problems, comparison of networks and services, modulation techniques used for satellite communication. Indian satellite Scenario. (4L)

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Orbits- Orbital elements, orbital mechanics, geostationary orbit, change in longitude, orbital maneuvers, orbital transfer, orbital perturbations. Launch Vehicles- principles of Rocket propulsion, powered flight, Launch vehicles for communication satellite (4L)

Module IV:

RF link- noise, the basic RF link, satellite links (up and down) , optimization RF link, inter satellite link, noise temperature, Antenna temperature, overall system temperature, propagation factors, rain attenuation model. Tropospheric and Ionospheric EFFECT. (5L)

Multiple access- FDMA, TDMA, CDMA techniques, comparison of multiple access techniques, error correcting codes. Satellite subsystems and satellite link design- AOC S, TT&C, power system, spacecraft antenna, transponder, Friis Transmission equation, G/T Ratio of Earth stations.(4L)

Books:

1. Wireless Networks: Applications and Protocols, T. S. Rappaport, Pearson Education
2. Wireless Communication and Networks : 3G and Beyond, I. Saha Misra, TMH Education.
3. Satellite communication – D. Roddy (TMH)
4. Satellite Communication: Maini & Agarwal (Wiley)

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name: VLSI DESIGN					
Course Code : ECEN 4282					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:
After completing this course, the students will be able to:

1. Understand different MOS structures and functions in order to apply the knowledge in building CMOS circuits.
2. Classify VLSI Design Cycle, Style and Methodology.
3. Identify logic and performance of CMOS combinational and sequential logic.
4. Construct physical layout design and stick diagram of digital gates.
5. Use various synthesis flow and HDL modeling in ASIC Semi custom design.
6. Interpret Si testing and debug related algorithms and fault modelling.

Module I: VLSI Circuits & Physical Layout: [12L]
Unit1: MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop
Unit2: CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm

Module II: VLSI Design and Test Methodology: [10L]
Unit1: VLSI Design Cycle, Y-Chart, Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX,
Unit2: Si Testing: Why Testing, Challenge of Si-Testing, Manufacturing Defects, Die (Inter and Intra) Variation, Yield, DPM, Logical Fault Modelling: Stuck at Faults (D-Algorithm), Bridging Fault, Transistor Stuck open/Stuck Short, ATPG, DFT, Scan Design

Module III: Front-end Design: HDL: [8L]
Why HDL ? Frontend Design Flow using HDL (Behavioral, RTL and Gate Level), Verilog Coding, Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed, FSM Example: Mealy Machine and Moore Machine.

Module IV: Backend Design: VLSI Memory Circuit: [10L]
Types of Memory, Memory Organization, Memory Folding Criteria, DRAM 4T, 3T, 1T Cell Design Method, SRAM 8T, 6T Cell Design Method, Sense Amplifier Operation: Differential Amplifier based and Latch Based, Multiport Register File Design Challenges, Mask ROM, ROM Programming Techniques, Flash ROM

Text Book:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000
2. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Reference Book:

1.CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006
2.Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
3.VLSI Design and EDA TOOLS, Author: Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, SCITECH PUBLICATIONS (India) Pvt. Ltd., 2011

Course Name: VLSI TESTING AND VERIFICATION					
Course Code : ECEN 4283					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:
After completing this course, the students will be able to:

1. Apply the previous knowledge gathered from the courses on Semiconductor Physics and Digital Computer.
2. Construct Y Chart representing the VLSI Design Cycle.
3. Design complex logic circuits with either nMOS or CMOS transistors.
4. Solve combinatorial and sequential logic design problems.
5. Evaluate the correct logic of a digital circuit with test vectors.
6. Analyze the timing characteristics of a digital logic circuit.Understand D and ATPG algorithm for VLSI testing.

Module I: VLSI Design Methodology: [6L]

Unit1: Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node,

Unit2: Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX, VLSI Design Cycle, Y-Chart.

Module II: VLSI Circuits & Physical Layout: [10L]

Unit1: MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop

Unit2: CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm, Layout Legging.

Module III: VLSI Verification Flows and Static Timing Analysis: [12L]

Unit1: Logic Verification, Circuit Verification, Layout Verification (DRC, LVS), pre-layout simulation, parasitic Extraction and Back-annotation, post layout verification,

Unit2: Timing checks (set-up, hold), process variation study with PVT analysis, Library Cell characterization, Static Timing Analysis: Types of Path for Timing Analysis, Launch path, Capture Path, Longest Path, Shortest Path, Critical Path, Clock Skew

Module IV: Si-Testing: [12L]

Unit1: Why Testing, Challenge of Si-Testing, Manufacturing Defects, Die (Inter and Intra) Variation, Yield, DPM, Combinational Circuit Testing: Logical Fault Modelling: Stuck at Faults (D-Algorithm), Bridging Fault, Transistor Stuck open/Stuck Short, ATPG, Path Delay Fault,

Unit2: Sequential Circuit Testing: DFT, Scan Design, SFF, LSSD-SSF, BIST

HOD, ECE Department
Heritage Institute of Technology
Kolklata

Text Books:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2^{nd} Edition, 2000
2. VLSI Test Principles and Architectures, Design for Testability, Author: Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, The Morgan Kaufmann series in Systems on Silicon. 2006 Elsevier

Reference Books:

3. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011
4. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall

Free Elective offered to other Department

Course Name : **Circuit Theory Analysis (Free Elective)**					
Course Code: **ELEC4182**					
Contact hrs per week :	L	T	P	Total	Credit points
	3	0	0	3	3

Module-I

Network equations: Formulation of Node & Mesh equations. Loop and node variable analysis. Network theorems: Thevenin's theorem, Norton's theorem and Superposition theorem applied to circuits containing dependent sources. [9L]

Module-II

Laplace Transform: Review of Laplace transform. Properties of Laplace transform. Transform of standard periodic and non periodic waveforms. Circuit elements and their transformed equivalents. Transient and steady state response of RL, RC, LC and RLC with or without stored energy. Concept of natural frequency and damping. [9L]

Module-III

Graph theory: Graph of network: Concept of path, tree, tree branch, tree link, loop, tie set and cut set. Incidence Matrix, tie-set Matrix and f-cut set matrix and their properties. Loop currents and node-pair potentials, formulation of loop and node equilibrium equations in view of graph theory. [9L]

Module-IV

Two port networks: Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters and Hybrid parameters. Inter relation between parameters. Inter connection between two port networks. Driving point & transfer impedance & admittance. [9L]

Text Books:

1. Networks and Systems, D. Roy Chowdhury, New Age International Publishers
2. Circuit theory, Dr. Abhijit Chakrabarty, Dhanpat Rai & Co Pvt. Ltd.
3. Network Analysis, Van Valkenburg, Pearson Education .
4. Fundamental of Electric circuit theory, D. Chattopadhay & P.C. Rakshit, S. Chand.

References:

1. Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin,The Mc Graw Hill Company.
2. Modern Network Analysis, F.M.Reza & S.Seely, McGraw Hill.

Sd
HOD, EE

Free Elective offered to other Department

Course Name : Fundamentals of Illumination Engineering(Free Elective)					
Course Code: **ELEC4282**					
Contact hrs per week :	L	T	P	Total	Credit points
	3	0	0	3	3

COURSE OUTCOME

- To get acquainted with the laws of photometry for calculation of illuminance levels for different lighting applications
- To understand the principles of operation of different photometers
- To understand the principles of operation of different lamps and their accessories
- To analyse indoor lighting schemes and design energy efficient installations complying with lighting codes
- To design energy efficient road lighting installations in conformity with lighting codes
- To understand the parameters of sports lighting installations

Module – I **[9L]**

Illumination Engineering Basics and Photometers

Light and Electromagnetic Radiation, Visible spectrum of radiation.

Radiometric and photometric quantities, visual response curve of standard observer, relation between Lumen and Watt.

Laws of Illumination, perfect diffuser, Lambert's law.

Module – II **[9L]**

Lamps and its Accessories: Fluorescent tubes, compact fluorescent lamps (CFL), low and high pressure sodium vapour lamps, high pressure mercury vapour lamps, Light Emitting Diode (LED) lamps.

Ballast- function, electromagnetic and electronic types, principles of operation.

HOD, EE

Module – II [9L]

Lamps and its Accessories: Fluorescent tubes, compact fluorescent lamps (CFL), low and high pressure sodium vapour lamps, high pressure mercury vapour lamps, Light Emitting Diode (LED) lamps.

Ballast- function, electromagnetic and electronic types, principles of operation.

Module – III [9L]

Interior Lighting Design

Objectives, quantity and quality of light, selection of lamps and luminaires. Design considerations for lighting of offices, conference rooms, hospitals. Design calculations by lumen method in accordance with lighting code.

Module – IV [9L]

Outdoor Lighting : Road, Playground and Landscape Lighting Design

Basic concepts of outdoor lighting design- objectives, design parameters, qualitative & quantitative evaluation of outdoor lighting systems.

References / Books

1. Lighting Engineering Applied Calculations – R. H. Simons & A.R. Bean, Architectural Press
2. Applied Illumination Engineering, Second Edition, Jack L Lindsey, Prentice Hall.
3. Lamps and Lighting – Edited by J.R.Coaton and A.M.Marsden, 4th Edition Arnold
4. IES Lighting Handbook – IES North America.
5. National Lighting Code- Published by Govt of India,2011

HOD, EE

PROJECT-I

CODE: ELEC4191
CONTACT: 6P
Credit: 4

Project should be on any topic having relevance with Electrical Machines/Power systems/Control Systems/ High Voltage Engineering/ Instrumentation & Measurements or interdisciplinary field of engineering. The same should be decided by the student and concerned supervisor. Project should consist of research work done by the student in the selected topic with comprehensive and significant review of recent developments in the same field.

HOD, EE

PROJECT-II

CODE: ELEC4291
CONTACT: 12P
Credit: 8

The student has to continue the project work done in seventh semester. At the end of eighth semester, the student has to appear in examination (viva-voce & demonstration) before the panel of examiners to defense his/her work done in project. The candidate shall submit the project report in the prescribed format to the Head of the department, duly certified that the work has been satisfactorily completed.

HOD, EE

SEMINAR-I

CODE: ELEC4031
CONTACT: 3P
Credit: 2

The students are required to collect the resources on a specific topic comprehend it and present in the class. The paper topic should be relevant with Electrical Engineering and its related areas. The topic should be decided by the student and concerned teacher. The students should submit a report consisting of a preliminary outline of paper, a list of the references that they have reviewed to date, a short statement of the findings of the paper and analysis of how this information fits, or does not fit, into the paper. The candidate will deliver a final talk on the topic at the end of the semester and assessment will be made by a group of internal examiners.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Understand the contemporary/emerging technology for various processes and systems.
2. Learn the structure of technical document and how to write it.
3. Demonstrate the ability to deliver technical seminar.
4. Interact effectively with audience to share knowledge through presentation skill.

HOD, EE

SEMINAR-II

CODE: ELEC4032
CONTACT: 3P
Credit: 2

The students are required to collect the resources on any advanced topic relevant with Electrical Engineering and its related areas and present it in the class. The students should submit a report consisting of a preliminary outline of paper, a list of the references that they have reviewed to date, a short statement of the findings of the paper and analysis of how this information fits, or does not fit, into the paper. The candidate needs to deliver a final talk on the topic at the end of the semester and assessment will be made by a group of internal examiners.

Course Outcomes:
After the completion of the course, the students will be able to:
1. Understand the emerging technology related to EE.
2. Learn the structure of technical document and how to write it.
3. Demonstrate the ability to deliver technical seminar.
4. Interact effectively with audience to share knowledge through presentation skill.

HOD, EE

B.Tech in Electrical Engineering
4th Year, 1st Semester

ELECTRIC DRIVES & POWER UTILIZATION

Code: ELEC4101
Contact: 3L+1T

Course Outcomes:
Students will be able to:

- Know the stable steady state operation and transient dynamics of motor-load system.
- Learn characteristics and control of solid state DC motors drives, induction motor drives & Synchronous motor drives.
- Acquire knowledge about electric traction systems and their industrial applications.
- Understand the principles of operation of different lamps and different photometers and to analyze indoor lighting schemes.
- Learn different methods of electric heating and welding.

MODULE I
Electric Drives:
Concept, classification, parts and advantages of electrical drives. Types of Loads, Components of load torques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of moment of inertia, Steady state stability, Transient stability. Multiquadrant operation of drives.

Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods of determination of rating for fluctuating and intermittent loads. Effect of load inertia & environmental factors. Choice of couplings and bearings.

[8L]

MODULE II
AC & DC Drives:
Types of braking, braking of DC motor, Induction motor and Synchronous motor, Single phase, three phase fully controlled DC drives, Dual converter fed drives, Armature current control with constant flux and field weakening, Drive schemes with armature voltage feedback, IR-compensation and tacho feedback for both constant flux and field weakening. Chopper controlled DC motor drives. Stator voltage variation by three phase controllers, Speed control using dynamically varying resistance in the rotor circuit, slip power recovery schemes. Pulse width modulated inverter fed and current source inverter fed induction motor drive. Volts/Hertz Control, Basics of Vector or Field oriented control. [12L]

MODULE – III
Electric Traction:
Introduction, Requirements of Ideal Traction System Supply system for electric traction, Train movement (speed time curve, simplified speed time curve, average speed and schedule speed). Co-efficient of adhesion.
Mechanism of train movement (energy consumption, tractive effort during acceleration, tractive effort on a gradient, tractive effort for resistance, power & energy output for the driving axles, factors affecting specific energy consumption, coefficient of adhesion). The traction motors starting, Breaking of Traction motors.

HOD, EE

Use of AC series motor and Induction motor for traction. Current collection in traction system.
[10L]

MODULE – IV
Illumination Engineering:
Light and electromagnetic radiation.
Radiometric and photometric quantities, visual response curve of standard observer, relation between lumen and watt.
Laws of illumination, perfect diffuser, Lambert's law.
Photometry - Bench photometer, Luxmeter, Integrating sphere, Distribution photometer.
Lamps-general classification, filament, discharge, fluorescent – construction, principle of operation, applications.
Elementary lighting design- design parameters, BIS recommendation, General indoor lighting design by Lumen method.
Concepts of energy efficient lighting design and payback calculation.
[5L]

Electric Heating welding:
Introduction, Different methods of heating: resistance heating, Induction heating, Dielectric heating, Arc heating, microwave heating , Electric welding, Different welding methods, current control of welding transformer, Ultrasonic and laser welding. Arc furnaces : Basic Principles.

Storage Batteries: Common types and their characteristics, Principles of charging, Modes of charging, eg., Tickle, Float, Boost, Constant current, constant voltage, Battery size estimation.

[5L]

Text Books:
1. Dubey.G.K., "Fundamentals of Electrical drives", Narora publications, 1995.
2. Vedam Subramanyan, "Thyristor control of Electrical Drives", Tata McGraw Hill, Publications, 1996.
3. Bimal K. Bose, "Modern Power Electronics and AC Drives", Prentice Hall of India, 2005.
4. J.B.Gupta,"Utilization of Electric power and Electric Traction", Kataria Publishers.
5. H. Partab, "Art and Science of Utilization of Electrical Energy", Dhanpat Rai & Sons.

References:
1. R. Krishnan, "Electric motor drives Modeling, Analysis and Control", 1st edition, Pearson Publications, 2009.
2. C.L. Wadhawa, "Generation Distribution and Utilization of Electrical Energy", New Age International Publishers.
3. E.Openshaw Taylor, "Utilisation of Electric Energy", Orient Longman.
4. W.Shepherd, L.N. Hulley, & D.T.W. Liang, "Power Electronics and Motor Control", Cambridge University Press.

HOD, EE

High Voltage Engineering
Code: ELEC4102
CONTACT: 3L+1T

On successful completion of this course, the student is capable of:

- deriving the equations for electric stress enhancement in high voltage insulation.
- explaining the physical process of breakdown - based on the Townsend, Streamer and Leader models
- describing and explaining the standard HV tests, and design the test generator circuits for ac, dc and impulse voltages (and currents).

Module: I

Introduction

Electric Field, Dielectric Strength, Electric Field in Some Geometric Boundaries, Solid Dielectrics, Liquid Dielectrics, Gas/Vacuum Dielectrics. (2L)

Overvoltage Phenomenon and Insulation Coordination

Natural Causes for Overvoltage – Lightning Phenomenon, Switching Surges, System Faults and Other Abnormal Conditions, Insulation Coordination on High Voltage and Extra High Voltage Power Systems (6L)

Module: II

Breakdown Mechanism

Conduction and Breakdown in Gases: Townsend Mechanism, Paschen's Law, Streamer Theory of Breakdown in Gases, Breakdown in Electronegative Gases, Time Lags for Breakdown, Breakdown in Non-Uniform Fields and Corona Discharges, Vacuum Insulation (6L)

Conduction and Breakdown in Liquids: Pure Liquids and Commercial Liquids, Conduction and Breakdown in Pure Liquids, Conduction and Breakdown in Commercial Liquids. (3L)

Breakdown in solid dielectrics: Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown, Breakdown of Solid Dielectrics in Practice, Breakdown in Composite Dielectrics. (3L)

Module: III

Generation of High Voltages and Currents

Generation of High AC Voltage – Testing transformer and its cascade connection, single-phase series resonance circuit, **Generation of High DC Voltage** – Single-stage and multi-stage symmetric as well as asymmetric voltage multiplier circuits, **Generation of Impulse Voltage and Current** – Single-stage and multi-stage impulse generators circuits, Triggering and synchronization with CRO. (10L)

HOD, EE

Module: IV

Measurement of Voltages and Currents

Measurement of High DC Voltage – Ammeter in series with high resistance, Resistance potential divider, Generating voltmeters, Sphere gaps. **Measurement of Power Frequency High AC Voltage** – Capacitive Voltage Transformer, Potential Dividers, Electrostatic Voltmeter, Sphere gaps. **Measurement of Peak value of high AC Voltage – Frequency dependent method**: Chubb & Fortescue Method, **Frequency independent methods**: Davis-Bowdler Method, Rabus Method. **Sphere-Gap Method** for measurement of High DC, AC and Impulse Voltages (Peak Values). **Measurement of High DC, AC and Impulse Currents -** Hall generator, Current transformer, Resistive shunts, Rogowski coil, **Cathode Ray Oscillographs for Impulse Voltage and Current Measurements.** Measurement of **Dielectric** Loss-factor – High Voltage Schering Bridge. **Partial Discharge Measurements**
(10L)

Text Book:

1. High Voltage Engineering Fundamentals – John Kuffel, E.Kuffel , W.S Zaengal.
2. High Voltage Engineering: Theory and Practice - Mazen Abdel-Salam.
3. High Voltage Engineering – M.S Naidu, V. Kamraju.
4. High Voltage Engineering – C. L. Wadhwa.
5. High Voltage Technology –Liviu Leonard Alston.
6. High Voltage Measurement Techniques- A.J.Schwab.
7. High Voltage Engineering -V. Razevig & M.P. Chourasia.
8. High Voltage Insulation engineering – Ravindra Arora, Wolfgang Mosch.

HOD, EE

Professional Elective – III

ADVANCED POWER SYSTEM
CODE: ELEC4161
CONTACT: 3L

COURSE OUTCOME
Students will be able
1. To understand the Economic Operation of Power Generation Systems
2. To understand the advantages and operation of HVDC transmission system .
3. To learn about power system transients.
4. To know about the frequency Control in Power System.
5. To learn about the voltage control and reactive power compensation in power system.

MODULE-I

Economic Operation of Energy Generation Systems
Generator Cost Curves; Economic Operation of Thermal Power plants ; Transmission Loss and Penalty Factor; Necessity of Hydro-Thermal Scheduling; Unit Commitment problem- various costs and constraints, solution of Unit Commitment problem. [12]

MODULE-II

Introduction to HVDC: Introduction to DC power transmission technology, comparison of AC and DC transmission, Components of HVDC transmission , Configurations of DC transmission system [4]

Power System Transients: Types of Power System Transients; Overvoltage in Transmission Lines; Propagation of Surges and Travelling Waves; Reflection and Refraction coefficient; Bewley's Lattice Diagram, Protection against Over-Voltage Transients in Power System. [7]

MODULE-III

Automatic Generation Control
Concept of AVR and ALFC Loops, Representation of Speed Governors, Turbines, Generators and loads; Exciter and VAR Control; Single Area Load Frequency Control. [7]

MODULE-IV

Reactive Power Sensitivity and Voltage Control; Shunt and Series Compensation; Introduction to different FACTS devices, their principle of operation and their role in reactive power and voltage control. [10]

HOD, EE

TEXT BOOKS:

1. HVDC Power Transmission Systems –Technology & System Interaction by K.R.Padiyar, Willey Eastern.
2. Modern power system analysis, D.P. Kothari & I.J. Nagtrath, Tata McGraw Hill.
3. Power generation operation & control, A.J. Wood & B.F. Wollenberg, Wiley India.
4. Power System Stability and Control by Prabha Kundur, Tata McGraw Hill.
5. Electric Energy Systems Theory by O.I. Elgard, Tata McGraw Hill.

REFERENCE BOOKS:

1. Power system analysis- S.Sivanagaraju
2. Power system Analysis, operation & control, Chakrabarty & Haldar, 2nd edition, PHI.
3. Power System Operation and Control, Umakant Rao,
4. Electrical Power System by C.L Waldha, New age International Publication

ADVANCED CONTROL SYSTEM
CODE: ELEC4162
CONTACT: 3L

COURSE OUTCOMES OF ADVANCED CONTROL SYSTEM

Students will be able to

- Know the fundamental concepts of Nonlinear Control systems
- Analyze Nonlinear systems by describing function and phase plane method
- Analyze the stability of a nonlinear system by Lyapunov theory
- Acquire knowledge about sampled data control systems
- Acquire knowledge about importance of observers in control systems
- Know the fundamental concepts of optimal control systems

Module I

Introduction to nonlinear systems:

Block diagram and characteristics of nonlinear systems. Common type of nonlinearities. 2L

Nonlinear system analysis: concepts of phase plane analysis .Phase plane analysis of linear and nonlinear systems. Methods of obtaining phase plane trajectories by graphical method, isoclines method. Qualitative analysis of simple control systems by phase plane methods. Limit cycles 5L

Describing function analysis. Stability analysis by describing function technique. Prediction of limit cycles using describing function technique. 5L

Module II

Stability analysis by Lyapunov theory:

Stability concepts for nonlinear systems. BIBO Vs state stability. Definitions of Lyapunov functions. Lyapunov analysis of LTI systems. 4L

Concept of Asymptotic stability, Global asymptotic stability. The first and second methods of Lyapunov to analyze nonlinear systems. Concepts of linearization. Design of control systems using Lyapunov's Methods. 5L

Module III

Analysis of discrete time (sampled data) systems using Z-transform:

Review of Pulse transfer function. Practical sampled data systems and computer control systems. Zero order hold. Approximation of discrete (Z-domain) controllers with ZOH by Tustin transform and other methods. State variable analysis of sampled data system. Discrete time control system design by root locus method. Digital compensator design using frequency response. Design of digital PID controllers. 10L

Module IV

Observers in control systems:

State observers. Design of full order state observers. Observer based state feedback control systems. Reduced order state observers. 4L

HOD, EE

Introduction to Optimal Control Systems:
Introductory concepts of Optimal Control Systems and Performance Indices. Concepts of regulator problem, tracking problem. Hamilton-Jacobi equation. Optimal Control of linear systems with Quadratic Performance Index. Numerical solution of Riccati equation. 5L

Text Books:

1. Control Systems: Principles and Design, M Gopal, TMH
2. Modern Control Engineering, Ogata;Katsuhiko, PHI
3. Automatic Control Systems, B.C. Kuo & F. Golnaraghi, 8th Edition, PHI
4. Control system Engineering: I.J. Nagrath & M. Gopal, New Age International.

Reference books:

1. Digital Control & State Variable Methods: M. Gopal, 2nd Edition, TMH
2. Control System Engineering: D. Roy Chowdhuri, PHI

HOD, EE

Electric Drives Lab
Code: ELEC4111
Contact: 3P

1. Study of thyristor controlled DC Drive.

2. Study of Chopper fed DC Drive.

3. Study of AC Single phase motor and speed control using TRIAC.

4. PWM Inverter fed 3 Phase Induction Motor control.

5. VSI / CSI fed Induction motor Drive analysis using Software/Hardware.

6. Study of V/f control operation of 3Φ induction motor drive.

7. Study of permanent magnet synchronous motor drive fed by PWM Inverter using Software/Hardware.

8. Regenerative / Dynamic braking operation for DC Motor - Study using Software/Hardware.

9. Regenerative / Dynamic braking operation of AC motor - Study using Software/Hardware.

10. Dual converter fed DC Motor Drive for realization of four quadrant operation.

HOD, EE

Electrical Machine Design
ELEC4121
Contact: 3P

- Designing a heating element with specified wattage, voltage and ambient temperature.
- Designing an air core grounding reactor with specified operating voltage, nominal current and fault current.
- Designing of a distribution transformer.
- Designing a three phase squirrel cage induction motor.
- Designing a three phase wound rotor induction motor.
- Designing a split phase squirrel cage induction motor for a ceiling fan or a domestic pump.
- Designing a permanent magnet fractional hp servo motor.
- Designing of an electronic ballast.

HOD, EE

Electrical System Design
Code : ELEC4221
Contact: 3P

- Designing the power distribution system for a small township.
- Designing a double circuit transmission line for a given voltage level and power (MVA) transfer.
- Wiring and installation design of a multistoried residential building (G+4,not less than 16 dwelling flats with a lift and common pump)
- Designing of a substation
- Design the control circuit of a Lift mechanism
- Design a controller for speed control of DC machine.
- Design a controller for speed control of AC machine.
- Design an energy efficient lighting scheme for residential, commercial, hospital and other indoor areas.
- Design a road lighting scheme for various types of roads according to BIS specifications.

HOD, EE

Course Name : Telemetry and Remote Control					
Course Code: AEIE4101					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [11L]

Introduction to telemetry principles: Basic systems, classifications, non electrical telemetry systems, voltage and current telemetry systems.

Networking protocols for wired system – TCP/IP & P2P protocols.

Basics in Wireless systems – WiMAX, ZigBee and Bluetooth, power line carrier communication.

Module II – [9L]

Review of digital modulation techniques: MPSK, QAM, FDM systems – architecture & standards, TDM systems (architecture), synchronization.

Signaling for instrumentation systems – wireless system, Wireless sensor network, Satellite system.

Module III – [9L]

Satellite telemetry system - general considerations, telemetry and Tele-command, SCADA for communication system.

Optical fiber cable – dispersion, losses, connectors and splices, transmitter and receiving circuits, coherent optical fiber communication system, wavelength division multiplexing, trend in fiber optic device development – examples of an optical telemetry system.

Module IV – [11L]

Remote control and its importance for independent messages and combinatorial message sharing. Telemetry systems in process industries, Power system telemetry.

Introduction to IoT, Basic sensor networks, Architecture of IoT system, MQTT protocol.

Video conferencing systems for Telemedicine, Telemedicine standards (DICOM).

References:

1. D. Patranabis, *Telemetry principles*, TMH, New Delhi
2. E. L. Gruenberg, *Handbook of Telemetry and Remote control*, Mc Graw Hill
3. B. P. Lathi, *Modern Digital and Analog Communication Systems*, Oxford University Press
4. G. Swobada, *Telecontrol Method and Application of Telemetering and Remote Control*, Von Nostrand.
5. Ginz Beng "Fundamentals of Automation and Remote Control".
6. Feng Zhao and Leonidas. J. Guibas, Wireless Sensor Networks: *An Information Processing Approach*, Morgan Kaufmann.

Course Outcomes:

After the completion of the course students will be able to

1. Design and handle a transmitting and receiving section of a telemetry system.
2. Design biotelemetry system used in critical cases.
3. Handle computerized control wireless telemetry system.
4. Recognize and explain at a basic level fundamental principle of digital communication systems
5. Demonstrate proficiency and conceptual understanding in current and voltage telemetry systems.
6. Use data acquisition and distribution systems for telemetry in process plants

Course Name : Power Electronics and Drives					
Course Code: AEIE4102					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [9L]

Power semiconductor devices: power diodes, power BJT, power MOSFET, SCR, DIAC, TRIAC and IGBT: construction, characteristics, working principles, applications.

Module II - [9L]

Thyristor:

Principle of operation of SCR, specification and rating, static characteristics, two-transistor analogy, SCR construction, gate characteristics of SCR, turn-on methods of SCR, dynamic turn-on switching characteristics, turn-off mechanisms (commutation), thyristor protection with snubbers and inductors.

Module III - [11L]

Phase controlled rectifiers:

Single phase converters: half controlled and full controlled converter, evaluation of input power factor and harmonic factor, continuous and discontinuous load current, single phase dual converters, power factor improvements, extinction angle control, symmetrical angle control, PWM, single phase sinusoidal PWM, single phase series converters, applications.

Three Phase Converters:

Half controlled and full controlled converters, evaluation of input power factor and harmonic factor, continuous and discontinuous load current, three phase dual converters, power factor improvements, three-phase PWM, twelve phase converters, applications.

Inverters:

Single phase and three phase (both 120° mode and 180° mode) inverters - PWM techniques: sinusoidal PWM, modified sinusoidal PWM, multiple PWM, introduction to space vector modulations, voltage and harmonic control, series resonant inverter, current source inverter.

Module IV - [11L]

Choppers:

Step-down and step-up chopper - time ratio control and current limit control – buck, boost, buck- boost converter.

Cycloconverters:

Single phase to single phase cycloconverter, three-phase half wave converters, cycloconverter circuit for three-phase output.

DC drives:

Basic machine equations, schemes for D.C motor speed control, single phase separately excited drives, braking operation of rectifier controlled separately excited drives, D.C chopper drives, phase-locked loop (PLL) controlled D.C drives.

AC drives:

Basic principle of operation, speed control of induction motor, stator voltage control, variable frequency control, rotor resistance control, slip power recovery scheme, synchronous motor drives.

References:

1. Shashi B. Dewan, Alan Straughen, Power Semiconductor Circuits, Wiley-Blackwell.
2. D. Bedford & R. G. Hoft, Principles of Inverter Circuits, John Wiley & Sons.

3. M H Rashid, *Power Electronics*, Pearson Education.
4. P C Sen, *Modern power electronics*, S. Chand.
5. Lander ,*Power Electronics*, McGraw Hill.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Gain practical knowledge about power electronic devices.
2. Analyze various single phase power converter circuits and understand their applications.
3. Gain practical knowledge about using simulation software in power electronics.
4. Design and simulate gate firing circuits.
5. Design and simulate rectifier, chopper and AC voltage controller
6. Develop skills to build and troubleshoot power electronics circuits.

Course Name : Telemetry and Remote Control Lab					
Course Code: AEIE4111					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Study of voltage telemetry system using a process variable transducer.
2. Study of 4-20 mA current telemetry system: 2 wire and 3 wire systems.
3. Study of a frequency telemetry system using a VCO and a PSD.
4. Study of a FDM and De-multiplexing system using wire transmission for 2 to 4 channels.
5. Study of a PCM system.
6. Study of a Bio-Telemetry System.
7. Study of a (wireless) remote control system.
8. Study of computerized control wireless telemetry system.

Course Outcomes:

After the completion of the syllabus, students will be able to acquire practical knowledge to

1. Design and handle a transmitting and receiving section of a telemetry system.
2. Design biotelemetry system used in critical cases.
3. Handle computerized control wireless telemetry system.
4. Recognize and explain at a basic level fundamental principle of digital communication systems
5. Demonstrate proficiency and conceptual understanding in current and voltage telemetry systems.
6. Use data acquisition and distribution system for telemetry in process plants

Course Name : Power Electronics and Drives Lab					
Course Code: AEIE4112					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

List of Experiments:

1. Study of V-I Characteristics of an SCR.
2. UJT Triggering circuits for SCR.
3. Study of the operation of a single-phase fully controlled bridge converter supplying
   a) Resistive load
   b) R-L load with freewheeling diode including generation of triggering pulses for the devices for both continuous and discontinuous modes of conduction.
4. Study of V-I Characteristics of a TRIAC.
5. Simulation of DC to DC step down chopper.
6. Simulation of PWM bridge inverter using MOSFET/IGBT with R and R-L loads.
7. Simulation of single-phase AC regulator.
8. DC motor speed control using chopper.
9. AC motor speed control using DIAC-TRIAC assembly.

Course Outcomes:

After the completion of this course students will be able to:

1. Gain practical knowledge about power electronic devices.
2. Analyze various single phase power converter circuits and understand their applications.
3. Gain practical knowledge about using simulation software in power electronics.
4. Design and simulate gate firing circuits.
5. Design and simulate rectifier, chopper and AC voltage controller
6. Develop skills to build and troubleshoot power electronics circuits.

Course Name : Industrial Training Evaluation					
Course Code: AEIE4131					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	-	-	2

This course has been designed for the students to gain real life working experience by visiting a Process Plant / Industry for a specified period. Thus, each & every student of AEIE should undergo industrial training for 4 weeks, during 6^{th} – 7^{th} Semester break in reputed Private / Public Sector / Government organization / companies. After completation of this course each student has to submit a report based on their industrial trainning and give a prtesentation on the same topic.

Course Outcomes:

After the completion of this course students will be able to:

1. Correlate their theoretical understanding with practical implementation.
2. Communicate effectively with other professional and non-professional groups in an industry/organization.
3. Identify, formulate and model problems; and find engineering solution based on a systems approach.
4. Become a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurship skills.
5. Aware of the social, cultural, global and environmental responsibility as an engineer.
6. Develop capability and enthusiasm for self-improvement through continuous professional development and life-long learning.

Course Name : Advanced Process Control					
Course Code: AEIE4141					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [10L]

Digital control loop with continuous process and digital controller, advantages & limitations of digital control. Signal discretization - sampling of continuous signal, sampling period considerations, sampling as impulse modulation, sampled spectra & aliasing. Signal reconstruction – zero and first order hold. Z-transform techniques, pulse transfer function, mapping between S-plane and Z-plane. Stability studies: W - plane transforms, Jury stability criterion, effect of sampling period.

Module II – [10L]

Digital Control Algorithms: (a) dead beat control, (b) Dahlin's algorithm, c) position algorithm and velocity algorithm. Enhanced single loop control strategies: a) cascade control, b) time delay compensation, c) inferential control, d) selective control/override control, e) nonlinear control system: gain scheduling and fuzzy control, f) adaptive Control.

Module III – [8L]

Real-time optimization (RTO): Basic requirements, the formulation and solution of RTO problems, optimization methods. Overview of model predictive control system. Introduction to batch process control.

Module IV – [8L]

Design of automation system architecture: basic components and their functions; concept of different industrial communication: ISO/OSI reference model, data highway and field-bus; Industrial networking: network access protocols – TDMA, CSMA/CD, token passing, master – slave, network transmission media – twisted pair, co-axial, fiber optic, network topology – mesh, ring, star, bus; concept of redundancy and necessity in process plant; design of SCADA system; client server concept and design; different level of automation.

References:

1. Seborg, D., Edgar, T., and Mellichamp, D., Process Dynamics and Control, Wiley & sons, New York, 1989.
2. G.Stephanopoulos, *Chemical Process Control-An Introduction to Theory and Practice* Prentice Hall of India, New Delhi, 2nd Edition, 2005.
3. B.W. Bequette, *Process Control Modeling, Design and Simulation*, Prentice Hall of India, New Delhi, 2004.
4. Luyben, W.,Process Modeling, Simulation and Control for Chemical Engineers, McGraw Hill, New York, 1990.
5. Curtis D.Johnson, *Process Control: Instrumentation Technology*, Prentice Hall College Div; Custom edition, 2008.
6. C.L.Smith and A.B Corripio., *Principles and Practice of Automatic Process Control*, John Wiley and Sons, New York, 2nd Edition 1998.
7. Paul W. Murril, *Fundamentals of Process Control Theory*, 3rd Edition, ISA press, New York, 2000.
8. Bela G. Liptak, *Instrument Engineers' Handbook,: Process Control*, CRC Press; 3rd edition, 1995.

Course Outcomes:

After completion of the course students will be able to

1. Apply knowledge of Mathematics, Science and engineering to develop the process models in digital domain
2. Analyze stability of the system in digital domain
3. Able to develop algorithms for design of various controllers
4. Formulate real time optimization (RTO) problems; apply optimization methods for the possible solutions
5. Learn the architecture of automation systems
6. Familiar with the protocols used for designing of automation systems

Course Name : Soft Computing					
Course Code: AEIE4142					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [7L]

Introduction to soft computing- fuzzy computing, neural computing, genetic algorithm and stochastic algorithm; introduction to different hybrid systems: fuzzy-conventional, neuro-fuzzy, neuro-genetic, genetic-fuzzy systems.

Introduction to fuzzy logic: benefits and application scope of fuzzy logic, distinguish fuzzy set and crisp set, fuzzy set theory, membership functions, fuzzy relations.

Module II - [10L]

Fuzzy systems: different fuzzy implications, compositional rule of inference, normalization and de-normalization, fuzzification, fuzzy rule-base design, defuzzification procedures, steps to design fuzzy controllers.

Module III - [10L]

Neural network: biological neuron and evolution of neural network, model of artificial neuron, architectures, single-layer NN Systems, applications.

Back propagation neural network, radial basis function network.

Neuro and neuro fuzzy control: structure, optimization and case studies.

Module IV - [9L]

Genetic algorithm: introduction, encoding, operators of genetic algorithm, basic genetic algorithm.

Hybrid system: integration of neural networks, fuzzy logic and genetic algorithms.

References:

1. J. S. R. Jang, C. T. Sun and E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI, 2004, Pearson Education 2004.
2. Dirankov, Hellendoorn and Reinfrank, *An Introduction to Fuzzy Control*, Narosa Publishing House.
3. Davis E. Goldberg, *Genetic Algorithms: Search, Optimization and Machine Learning*, Addison Wesley, N.Y., 1989.
4. S. Rajasekaran and G. A. Vijaylakshmi Pai, *Neural Networks Fuzzy Logic, and Genetic Algorithms*, Prentice Hall of India.
5. J. Yen and R. Langari, *Fuzzy Logic, Intelligence, Control and Information*, Pearson Education.
6. S. Haykin, *Neural Netowrks*, Prentice Hall of India.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Classify the soft-computing into the different computing methods based on their application, knowledge-base, mode of operation, construction, etc.
2. Explain the functions and properties of different fuzzy sets and compare with crisp set, explain different fuzzy relations and implications.
3. Design and analyze the different components of fuzzy controller appropriately to obtain the best possible fuzzy controller that can be applied to any process control systems.
4. Identify different component of biological and artificial neural network, and acquire knowledge of different ANN terminologies to apply in solving control problems.
5. Analyze and design algorithms for different supervised and unsupervised learning networks.
6. Illustrate biological background and give idea about basics of genetic algorithm and its application in optimizing controller parameters.

Course Name : Power Plant Instrumentation					
Course Code: AEIE4143					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [6L]

Fundamental of power plant: Introduction, classification of power plants, resources for power generation, review of thermodynamics cycles related to power plants, fuel handling and combustion, steam generators, steam turbines, fans and pumps, components of turbo generators and auxiliaries.

Module II – [12L]

Instrumentation and control: Burner management system, drum level measurement-DP cell type, hydra step, furnace draft control, boiler drum level control, load demand control, combustion control, steam temperature control, steam pressure control, deaerator storage tank and condenser hot-well level control.

Module III – [10L]

Instrumentation for safety interlocks, emergency shutdown conditions, alarm annunciators. Turbine supervisory instrumentation system: measurement of vibration, eccentricity, rotor & casing movement, temperature of metal and lubricating oil, speed etc. Turbine control systems: speed, lube oil pressure/flow, temperature, tank level etc.

Module IV – [8L]

Water treatment plant: water sources, water quality (impurities), effects of impurities, measurement of impurities, feed water treatment, blow down control.
Pollution measurement and environmental regulations: NO_x, SO_x and CO_x and particulate measurement.
Introduction to hydel power plant, Introduction to nuclear power plant.

References:

1. K Krishnaswamy, M Ponni Bala, *Power Plant Instrumentation*, PHI, 2011.
2. Black & Veatch, *Power plant engineering*, Springer Science &Business Media, Inc. 1996.
3. L. L. Grigsby, *Electric Power Engineering Handbook*, CRC Press, 2001.
4. A.K. Raja, A.P. Srivastava, M. Dwivedi, *Power Plant Engineering*, New Age International (P) Ltd., 2006.

Course Outcomes:

After completion of the course students will be able to

1. Analyze and select thermodynamic cycles used for thermal power plant.
2. Design P&I diagrams for different control loops associated with thermal, hydral and Nuclear power plant.
3. Investigate, formulate and analyze the safety requirements during power plant operation and accordingly able to design instrumentation systems for safety interlocks in power plant.
4. Design Turbine supervisory instrumentation system.
5. Apply engineering knowledge towards the treatment of water for industrial use.
6. Apply contextual knowledge for analysis and measure of pollutant produced by thermal power plant.

Course Name : Instrumentation and Telemetry					
Course Code: AEIE4181					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [9L]

Measurement of pressure and vacuum: Introduction, diaphragm, capsule, bellows, bourdon tube, DP transmitters – capacitive, Mcleod gauge.
Flow rate measurement: head type flow meters – orifice, pitot tube, venturimeter; variable area flow meters –rotameters; electromagnetic flow meters; ultrasonic flow meters.

Module II – [9L]

Level measurement: float and displacers type instruments, resistive and capacitive type level instrument; D/P type sensors; ultrasonic level instruments.
Temperature measurement: RTD – working principle, different wired configuration, characteristics, typical industrial application; thermocouples – working principle, cold junction compensation, different types of thermocouples and their application in industry and laboratory, thermopiles, thermowells, thermistor, pyrometers.

Module III – [9L]

Basic classification of telemetry systems: voltage, current, position, frequency and time components of telemetering and remote control systems, quantization theory, sampling theorem, sample and hold, data conversion, coding, and conversion.

Module IV – [9L]

Multiplexing; time division multiplexers and demultiplexer theory, scanning procedures, frequency division multiplexers with constant and proportional bandwidth, demultiplexers. Fundamentals of radio-telemetry system, RF link system design. Pipeline telemetry; Power system telemetry.

References:

8. B. G. Liptak, *Instrument Engineers Handbook, vol-I and vol-II*; Chilton Book Co. Philadelphia.
9. D. Patranabis, *Principles of Industrial Instrumentation*; TMH, New Delhi, 2nd Ed.
10. Eckman, *Industrial Instrumentation*; Wiley Eastern Ltd.
11. D. Patranabis, *Telemetry Principles,* Tata McGraw-Hill Education Pvt. Ltd.
12. Telemetry and Data Transmission", R. N Baral, *S. K. Kataria & Sons.*

Course Outcomes:

After the completion of the course students will be able to

1. Select the suitable pressure transducer in industrial pressure measurement.
2. Select the suitable flow transducer in industrial flow measurement.
3. Select the suitable level transducer in industrial level measurement.
4. Select the suitable temperature transducer in industrial temperature measurement.
5. Understand the functional components of voltage, current and frequency telemetry.
6. Familiar with the scheme of transmission of multiple sensor data based on time division multiplexing and frequency division multiplexing.

Course Name : Project I					
Course Code: AEIE4191					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	6	6	4

Project should be on any topic having relevance with Electronics, Instrumentation, Electrical or inter-disciplinary field of engineering. The same should be decided by the student and concerned supervisor. Project should consist of research work done by the student in the selected topic with comprehensive and significant review of recent developments in the same field.

Course Outcomes:

After the completion of this course students will be able to:

1. Demonstrate ability to identify and formulate real world engineering problems relevant to society needs; study its feasibility and methodology for implementation.
2. Apply knowledge of circuit design, sensor selection, signal processing, control system, embedded system and programming, etc., to implement the project work with proper time frame.
3. Implement hardware model along with its relevant software programming, conduct experiments, analyze and interpret data and explain them.
4. Prepare project report properly and demonstrate presentation confidently.
5. Develop regularity, engage in enduring learning, ability to work in a group and deal with existing project ethically.
6. Develop interpersonal communication skill and demonstrate sound technical knowledge of their project work.

Course Name : Analytical Instrumentation					
Course Code: AEIE4241					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [10L]

Introduction to analytical instrumentation: classification, types of instrumental methods.
Gas analysis: thermal conductivity method, heat of reaction method.
Oxygen analysis: magneto dynamic instrument (Pauling cell), thermo magnetic type or hot wire type instrument, zirconia oxygen analyzer, NO_x, CO_x analyzer.
Measurement of humidity, moisture, viscosity and density.

Module II - [8L]

Liquid analysis: electrodes-ion selective, molecular selective types- their variations.
pH analysis: pH electrodes, circuit for pH measurement and applications; conductivity cells: standards, circuits and applications; voltametry, polarography: apparatus, circuits and techniques-pulse polarography, applications.

Module III - [12L]

Colorimetry and Spectrophotometry:
Special methods of analysis, Beer-Lambert law, colorimeters, UV-Visible spectrophotometers; single and double beam instruments, sources and detectors. IR spectrophotometers: types, FTIR spectrophotometers, flame photometer, atomic absorption spectrophotometers: sources and detector; atomic emission spectrophotometers: sources and detectors, flame emission photometers, fluorescence spectrophotometer; X-ray diffractometer: working principle and applications; NMR: working principle and applications.

Module IV - [10L]

Separation methods: chromatography, basic definitions, instrumentation, some relations; gas chromatography (GC): basic parts, columns, detectors, techniques; liquid chromatography (LC): types, sources, detectors; high-pressure liquid chromatography (HPLC): sample injection system, column, detectors, applications; electrophoresis: theory, principle, instrumentation of horizontal and vertical electrophoresis; mass spectrometer: working principle and applications; GC-MS and its application area; microscopic techniques: TEM, SEM, STM and AFM.

References:

1. Principles of Instrumental Analysis- Skoog, Holler, Nieman, Publisher: Thomson Brooks/Cole
2. Handbook of Analytical Instruments- R.S. Khandpur, Publisher: Tata McGraw Hill
3. G.W. Ewing, 'Instrumental Methods of Analysis', McGraw Hill, 1992.
4. Introduction to Instrumental Analysis-Robert D. Braun, Publisher: Pharma Book Syndicate.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Select the required gas analyzer for the analysis of a particular gaseous component quantitatively.
2. Know the working principle of the instruments for the measurement of humidity, moisture and density.
3. Get ideas of different analytical methods like pH analysis, conductivity analysis etc.for liquid sample.
4. Understand UV-VIS , IR spectroscopic techniques for the liquid analysis.
5. Know X-ray spectroscopy and NMR spectroscopy for the analysis of sample.
6. Familiar with gas chromatography and liquid chromatography for sample analysis.

Mhaity

Course Name : Introduction to Embedded Systems					
Course Code: AEIE4182					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I- Introduction to an embedded system – [10L]

Different types of microcontrollers: embedded microcontrollers, introduction to AVR, PIC, ARM and Arduino based systems; processor Architectures: Harvard V/S Princeton, CISC Vs RISC; microcontroller memory types; microcontroller features: clocking, input/output pins, interrupts, timers and peripherals.

Module II- Overview of AVR microcontroller– [10L]

Introduction to AVR (ATmega 328p-pu) microcontrollers, architecture and pipelining, program memory considerations, addressing modes, CPU registers, ADC registers, instruction set, simple operations, basics of communication, overview of RS232, I²C Bus, UART, USB, ATmega 328p-pu connections to RS-232, ATmega 328p-pu serial communication programming, ATmega 328p-pu interrupts, programming of timer interrupts, programming of external hardware interrupts, programming of the serial communication interrupts, interrupt priority in the ATmega 328p-pu.

Module III- Embedded operating systems –[8L]

Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling; task communication: shared memory, message passing, remote procedure call and sockets, task synchronization: task communication/synchronization issues, task synchronization techniques, device drivers, how to choose an RTOS.

Module IV- Hardware Interfacing and Programming with ATmega 328p–[8L]

Interfacing of LCD, interfacing with analog sensors (i.e LM35, ADXL 335 accelerometer), interfacing of stepper motor, interfacing with a keyboard and MPU6050 (MEMS Accelerometer and Gyroscope) using I²C bus.

References:

1. Elliot Williams,"*AVR Programming: Learning to Write Software for Hardware*", Maker Media, Incorporated, 2014
2. Raj Kamal, "*Embedded Systems*", TMH, 2004.
3. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, "*The AVR Microcontroller and Embedded Systems: Using Assembly and C*"; Pearson, 2014.
4. Dhananjay Gadre, "*Programming and Customizing the AVR Microcontroller*"; McGraw Hill Education, 2014.
5. Silberschatz Galvin Gagne, "Operating System Concepts", WILEY, 2014

Course Outcomes:

After the completion of the course students will be able to

1. Define and design different embedded systems with microcontroller of different memory specification or RAM specification.
2. Design single purpose processors and basic architecture and operation, multipurpose controller-architecture, operation, codes and programming.
3. Define and understand timers and counters, Universal Synchronous Asynchronous Reciver and Transmitter and their classification.
4. Understand the application of different RAMs and ROMs and interfacing.
5. Understand different types of Interrupts and their service routine, describe RTOS, task-state, Semaphores. Understand the message queue, mailbox, and pipes.
6. Interface microcontroller and design the hardware and software to control the operation of I/o devices like LCDs, Keyboard, Stepper Motor, A/d converter etc.

Mhaly

Course Name : Comprehensive Viva Voce					
Course Code: AEIE4231					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	-	-	3

Every student should appear before a panel duly constituted by the members of faculties of the department in order to evaluate his/her knowledge in various subjects learned during the four years of study of the B. Tech AEIE course.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Answer questions from all the courses studied.
2. Attain oral presentation skills by answering questions in precise and concise manner.
3. Appear interview elegantly and confidently.
4. Judge themselves about their domain knowledge.
5. Develop habits of learning.
6. Gain confidence and inter-personal skills.

Course Name : Technical Seminar II					
Course Code: AEIE4232					
Contact hrs per week:	L	T	P	Total	Credit Points
	-	-	3	3	2

The main objective of this course work is to encourage self-learning in the field of student's own interest among the emerging areas of technology. The student is expected to do an extensive literature survey in his subjects of interest and present seminar on a research problem, available methods in literature, future trends, etc. to a group of experts.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Explore literature to identify promising new directions of various cutting edge technologies to solve real-world issues.
2. Build up knowledge in the field engineering, with specialization related to Electronics and Instrumentation engineering and the ability to integrate information across disciplines.
3. Prepare quality presentation on a topic with proper organization and demonstrate the content properly with the aid of audio-video, pictures and documents, etc.
4. Communicate effectively by making an oral presentation before an evaluation committee.
5. Interact efficiently with audience.
6. Develop habits of maintaining regularity and punctuality.

Course Name : Ultrasonic Instrumentation					
Course Code: AEIE4242					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [12L]

Introduction to ultrasonic waves, principle of propagation of various waves; characterization of ultrasonic transmission: reflection, refraction, diffraction, mode conversion, intensity, transmission coefficients and attenuation, sound field; ultrasonic transducers and their characteristics; generation of ultrasonic waves – magnetostriction and piezoelectric effect

Module II – [10L]

Ultrasonic equipments, A, B, M-scan presentation of test indications and interpretation; ultrasonic test methods: echo, transit time, resonance, direct contact and immersion types; interpretations and guidelines for acceptance/rejection; effectiveness and limitations of ultrasonic testing.

Module III – [6L]

Application of ultrasonic instrumentations for industrial application - NDT for flaw detection- pulse-echo method and associated instrumentations, transit time method and associated instrumentations, ultrasonic methods of measuring thickness, depth, flow and level.

Module IV – [12L]

Applications of ultrasonic instrumentation for medical diagnosis: ultrasonic in medical diagnosis and therapy, CT-scan acoustic holography, various parameters affecting ultrasonic testing and measurements, their remedy.

References:

1. J. Krauthsamer and H. Krauthsamer, Ultrasonic Testing of Materials, Springer Verlag, Berlin, New York.
2. N. T. Wells, Biomedical Ultrasonics, Academic Press, London.
3. J. David and N. Cheeke, Fundamentals and Applications of Ultrasonic Waves, CRC Press LLC.
4. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials; TMH, New Delhi, 2nd Ed

Course Outcomes:

After the completion of the course students to

1. Familiar with the fundamental principles of ultrasonic wave generation and propagation.
2. Know about ultrasonic equipments, A, B, and M-scan presentation of test indications and interpretation.
3. Develop knowledge on different ultrasonic methods of applications and their effectiveness and limitations
4. Apply the knowledge of ultrasonic instrumentation for non-destructive testing.
5. Learn ultrasonic methods of measuring thickness, depth, flow and level.
6. Know about the applications of ultrasonic instrumentations in medical sciences.

Course Name : Digital Control Systems					
Course Code: AEIE4243					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	-	4	4

Module I – [10L]

Introduction to digital control, basic elements of discrete data control systems, advantages of discrete data control systems, examples, discrete time system representation, sampling process and its mathematical modeling, signal reconstruction; review of z-transforms, applications of z-transforms to difference equations, mapping of s-plane to z-plane, zero order and first order sample and hold circuits.

Module II - [10L]

Transfer functions, block diagrams, pulse transfer function and z-transfer function, poles and zeros, discrete data system with cascaded elements separated by sampler and not separated by sampler.

Module III - [10L]

Closed loop response and stability of sampled data systems: determination of closed loop transient and steady state responses, stability in z-plane, bilinear transformation, Schur-Cohn stability criterion, Jury stability criterion; root locus method, design of sampled data control systems.

Module IV - [10L]

Design of digital control systems with digital controllers through bilinear transformation; digital PID-controller; different class of digital controllers, general synthesis method, dead beat response design, Dahlin design, ringing and placement of poles.

References:

1. Ogata, *Discrete Time control systems* ; 2nd ed. (PHI)
2. Kuo, *Digital control systems*; (Second Edition) Oxford University Press
3. M. Gopal, *Digital Control Engineering*; New Age Publ.
4. John Dorsey, *Continuous & Discrete Control Systems* ; MGH

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Acquire knowledge about fundamental concepts and techniques used in digital control system.
2. Understand and formulate the mathematical models of linear discrete time control systems.
3. Explain the concept of pulse transfer function and z-transfer function along with pole-zero.
4. Determine the transient and steady state behavior of process model.
5. Analyze the stability of the process model using different methods
6. Design digital controllers like digital PID.

Course Name : Sensor Technology					
Course Code: AEIE4281					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module I – [11L]

Overview of Sensors:

Sensor: classification of sensors; mechanical, electrical, thermal, acoustic, optical, chemical, bio- sensors, their calibration and determination of characteristics.

Module II - [11L]

Mechanical Sensors:

Displacement, acceleration, pressure sensing components, components of seismic system.

Electrical Sensors:

Temperature, pressure, flow, level sensing components

Acoustics Sensor:

Piezo electric sensor, microphones, ultrasonic sensors.

Module III - [10L]

Micro-Sensor:

IC technology used in micro sensor system; crystal growth and wafer making, different techniques of deposition; physical vapor deposition - evaporation, thermal oxidation, sputtering, epitaxy, ion implantation and diffusion; chemical vapor deposition- LPCVD, APCVD, PECVD, spin coating, electrochemical deposition; pattern generation and transfer-masking, photolithography: photoresists and application, light sources, photo resist development and removal; different types of etching: chemical and plasma; overview of micro-manufacturing techniques: bulk micro-machining, surface micro-machining, LIGA.

Testing and Packaging:

Partitioning, layout, technology constraints, scaling, compatibility study; scaling laws in miniaturization; examples of selected micro sensors.

Module IV - [4L]

Smart Sensors:

Introduction; present trends, nature of semiconductor sensor output, information coding, integrated sensor principles, sensor networking.

References:

1. J. W Gardner, V. K. Varadan, Microsensors, MEMS And Smart Devices, Wiley, 2001.
2. Stephen Beedy, MEMS Mechanical Sensors, Artech House, 2004
3. N. P. Mahalik, *MEMS*, McGraw Hill, 2007
4. Jon Wilson, Sensor Technology Handbook, Elseiver, 2005.
5. Leondes, Cornelius T. (Ed.), Mems/Nems Handbook Techniques and Applications, Springer, 2006
6. Mohamed Gad-el-Hak, *The MEMS Handbook*, CRC Press; 2nd edition, 2005.
7. B. G. Streetman and Sanjay Banerjee, Solid State Electronic Devices, Prentice Hall; 6th Edition, 2005.

Course Outcomes:

After the completion of the syllabus, students will be able to:

1. Distinguish different types of sensors.
2. Understand the characteristics of sensors and calibration procedure.
3. Grab the concepts and application of different mechanical, electrical and acoustic sensors.
4. Acquire the fundamental knowledge in micro sensors, sensor materials, properties and industrial applications.
5. Understand the application of IC technology and photolithography technique in micro sensors.
6. Learn the basics of sensor networking, coding and smart sensors.

Course Name : Control Systems and Applications					
Course Code: AEIE4282					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	-	-	3	3

Module-I-[10L]

Concepts of control systems – open loop and closed loop control systems, effect of feedback in control system; mathematical model of physical system - differential equation representation of physical systems, transfer function models, block diagram models, signal flow graphs, standard test signals, concept of system sensitivity.

Module-II-[6L]

Time response analysis - transient response of first order and second order with standard test signals, steady state error coefficients, effect of pole –zero addition in system response; time domain performance criteria.

Module- III-[10L]

Stability analysis - concept of stability, Routh stability criterion, root locus technique - root locus construction rules, stability analysis from root locus plot.
Introduction to frequency domain analysis –Bode plot - minimum and non minimum phase system, concept of phase margin and gain margin, procedure for drawing bode plots, assessment of relative stability –gain margin and phase margin .

Module –IV-[10L]

Models of control devices and systems - dc servomotors, ac servomotors, dc motor speed and position control, synchro.
Basic control actions- Introduction to conventional controllers (P, PI, PD and PID) and application.

References:

1. Nagrath I. J. and Gopal M., *Control System Engineering*, 5th Ed., New Age International Private Ltd. Publishers.
2. Kuo B. C., *Automatic Control Systems*, 8th Ed., Wiley India
3. Ogata K., *Modern Control Engineering*, 4th Ed., Pearson Education.
4. Dorf R. C. and Bishop R. H., *Modern Control Systems;* Pearson Education.
5. Norman S. N., *Control Systems Engineering*, 4th Ed., Wiley India.
6. B.W. Bequette, *Process Control Modeling, Design and Simulation*, Prentice Hall of India, New Delhi.

Course Outcomes:

After the completion of this course students will be able to:

1. Develop mathematical model of physical and simulated systems in forms of transfer function.
2. Represent the block diagram and signal flow graph of the systems.
3. Investigate the time response of systems and calculate performance indices.
4. Check the stability of a system using root locus method.
5. Analyze frequency response and stability of linear systems using Bode plot methods.
6. Understand the concept and utility of control action and its usage.

<table>
<tr><td colspan="6">Course Name : Project II</td></tr>
<tr><td colspan="6">Course Code: AEIE4291</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>-</td><td>-</td><td>12</td><td>12</td><td>8</td></tr>
</table>

The student has to continue the project work done in seventh semester. At the end of eigth semester, the student has to appear in examination (viva-voce & demonstration) before the panel of examiners (both external and internal) to defense his/her work done in project. The candidate shall submit the project report in the prescribed format to the Head of the department, duly certified that the work has been satisfactorily completed.

Course Outcomes:

After the completion of this course students will be able to:

1. Demonstrate ability to identify and formulate real world engineering problems relevant to society needs; study its feasibility and methodology for implementation.
2. Apply knowledge of circuit design, sensor selection, signal processing, control system, embedded system and programming, etc., to implement the project work with proper time frame.
3. Implement hardware model along with its relevant software programming, conduct experiments, analyze and interpret data and explain them.
4. Prepare project report properly and demonstrate presentation confidently.
5. Develop regularity, engage in enduring learning, ability to work in a group and deal with existing project ethically.
6. Develop interpersonal communication skill and demonstrate sound technical knowledge of their project work.

Course Name : PROFESSIONAL DEVELOPMENT					
Course Code: HMTS 4121					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	2

Course Outcomes:

The student will –

1. be able to map their skills according to the basic job profile.
2. upgrade and enhance generic and specific skills according to Washington Accord.
3. Undertake research and identify industry specific job opportunities and enhance career growth.
4. Be aware of the startup eco system in India.
5. Acquire tools to take up entrepreneurship as a career opportunity.
6. Achieve work-life balance by managing both organizational and personal crisis.

Module No.	Syllabus
Module 1	**ProfessionalGrowth** • Goal Setting- Characteristic of goals, Short-term and long-term goals, Goal-achievement timeline • Skill identification and Skill up gradation- Washington Accord and Skills for engineers (generic and specific), Local and global skills, Knowledge sources such as MOOC, NPTEL • Career Planning- Vision and mission, Skill mapping to job profile, Basic and add-on qualifications, Career growth, Self-appraisal, Lifelong learning Assessment - Activity (20 marks)

Module 2	**Entrepreneurship** • The start-up ecosystem in India- Why entrepreneurship?, Indian tech start-up landscape, Stand-up India policies, funding agencies, market development, trends and best practices • E-Commerce- India as a growing E-commerce market, Possibilities of growth, funding, niche retailers • Make in India- New processes, Investments, Focus sectors, Makers of Make In India, Opportunities, Policies Assessment-Project (30 marks)
Module 3	**Industry specific opportunities** • Industry prospects in India and Beyond • Industry-specific job opportunities • Research & Development • Other opportunities Assessment---Presentation (30 marks)
Module 4	**Working and living happily** • Managing crisis- Organisational and personal crisis, Analysing crisis, Turnaround strategies, Learning from crisis as opportunity • Work-life balance- Performance-expectation management, Personal and professional goal- mapping • Understanding happiness- Components, Conflicts, Happiness Index Assessment: Activity/case (20 marks)

Suggested Reading:

1. Basic Managerial Skill for All by E. H. McGrath.SJ. Pub:PHI, New Delhi.
2. The Start-up Equation by Steven Fisher and Jae-Nae Duane. Pub: Mc Graw Hill Education (India) Pvt. Ltd. New Delhi.
3. Live Happily, Work Happily by Siddhartha Ganguli. Pub: Allied Publishers Pvt.Ltd. New Delhi.
4. Crisis Management: Planning for the Inevitable by Steven Fink. Pub: iUniverseInc.USA.
5. Influencer:The New Science of Leading Change by Joseph Grenny&Kerey Patterson. Pub:McGraw Hill Education , USA.

09/08/2022

Course Name : INTRODUCTION TO INDUSTRIAL SOCIOLOGY					
Course Code: HMTS 4281					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After the completion of the course the student will be able to

1.Understand the various sociological aspects of Industry

2. Appreciate the historical perspective of industrial development and implement the lessons learnt in the modern context.

3. Develop awareness about the dynamics of the working of an organization and act accordingly

4. Analyze the impact of social changes on the functioning of industry.

5. Learn about the various aspects of industrial disputes and provide solutions.

6.Evaluate contemporary technical and social issues and adjust and adapt accordingly

Module 1/6hrs

Industry –the sociological perspective –sociology of work and industry, social relations in Industry

Social organisation in Industry-Bureaucracy, Scientific Management and Human relations

Module II/10hrs

Rise and Development of Industry

Early industrialisation-Types of productive systems-The Manorial or Feudal system, TheGuild system, The Domestic or Putting out System and The Factory system

Characteristics of the factory system, causes and consequences of industrialization, obstacles and limitations of Industrialisation

Industry in India

Module III/10hrs

Social impact of industrialization-Nature of modern societies, Social Change –nature, process, causes, factors- cultural, developmental, technological.

Emergence of Industrial Capitalism, Information Society after Industrial Society, Post modernity, Globalization and Convergence, Significance of the Service Sector, Work Restructuring and Corporate Management

Module IV/10hrs

Contemporary Issues –

Work experiences in Industry

Labour Characteristics in sociological perspectives

Worker, Supervisor and Management relations- An Overview 5X2

Industrial disputes- Causes, Strike, Lockouts

Preventive machinery of industrial disputes- Grievances and Grievance Handling Procedure

Worker participation in Management -Works Committee, Collective Bargaining, Bipartite and Tripartite Agreement, Code of Discipline, Standing Orders, Labour Courts and Industrial Tribunals (4)

<u>Reference:</u>

1. **Gisbert Pascal**, *Fundamentals of Industrial Sociology*, Tata McGraw Hill Publishing Co., New Delhi, 1972.

2. **Schneuder Engno V**, *Industrial Sociology* 2nd Edition, McGraw Hill Publishing Co., New Delhi, 1979.

3. **Mamoria C.B. And Mamoria S**., *Dynamics of Industrial Relations in India*.

4. **Sinha G.P. and P.R.N. Sinha**, *Industrial Relations and Labour Legislations*, New Delhi, Oxford and IBH Publishing Co., 1977.

5. **Nadkarni, Lakshmi**, *Sociology of Industrial Worker*,Rawat,Jaipur,1998.

6.**Bhowmick Sharit**,*Industry,Labour and Society*, Orient 2012.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Detailed syllabus of 8th semester

Course Name : Organizational Behaviour					
Course Code: HMTS-4201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	0	0	2	2

Module I

Introduction to Organizational Behaviour-Concept, Importance, Challenges and Opportunities (1L)

Personality-Meaning of Personality, Personality Determinants and Traits, Psychoanalytic Theory, Argyris Immaturity to Maturity Continuum Impact on organization.(2L)

Attitude-Concept, Components, Cognitive Dissonance Theory, Attitude Surveys. (2L)

Module II

Perception- Concept, Nature and Importance, Process of Perception, Factors influencing perception, Perceptual Selectivity, Shortcuts to Judge Others: Halo Effect, Stereotyping, Projection and Contrast Effects, Impact on Organization. (2 L)

Motivation-Definition, Theories of Motivation-Maslow's Hierarchy of Needs Theory,McGregor's TheoryX&Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory.(4L)

Module III

Leadership-Concept, Leadership Styles, Theories-Behavioural Theory: Ohio Studies, Michigan Studies, Blake & Mouton Managerial Grid; Contingency Theory: Fielder Theory. (4L)

Group Behaviour: Definition, Characteristics of Group, Types of Groups: Formal & Informal; Stages of Group Development, Group Decision making, Group Decision MakingVs Individual Decision Making. (4L)

Module IV

Organizational Design-Various organizational structures and their pros and cons.

Concepts of organizational climate and culture, Organizational Politics-Concept, Factors influencing degree of Politics (2L)

Conflict management- Concept,Sources of conflict, Stages of conflictprocess, Conflict resolution techniques,Tools-Johari Window to analyse and reduce interpersonal conflict, Impact on organization. (3L)

Suggested Readings:

1. Organization Behaviour by Stephen Robbins
2. Organization Behaviour by Luthans
3. Organization Behaviour by L.M. Prasad
4. Organization Behaviour: Text, Cases &Games by AswathappaK.

Course Name: Elementary Spanish for Beginners					
Course Code: HMTS4283					
Contact hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

<u>Module 1</u> – **<u>9L</u>**

The Spanish Alphabet, the vowels, pronunciation rules, stress and accents

Greetings, giving and requesting personal details

Resources for asking about words

The numbers, nationalities, professions
Gender
The three conjugations: **-ar**, **-er**, **-ir**
The verbs **ser**, **llamarse** and **tener**
Vocabulary Resources: the days of the week, the parts of the day, about habits
Expressing frequency
Asking and telling the time

<u>Module II</u> – **<u>9L</u>**

The **presente indicativo**
Some uses of **a**, **con**, **de**, **por**, **para** and **porque**
The definite article: **el**, **la**, **los**, **las**
Personal pronouns
Qualifiers: **bien**, **bastante bien**, **regular**, **mal**

Expressing intentions
Expressing existence and location
Vocabulary Resources: leisure activities, the weather, geography, tourist attractions

Speaking about physical appearance and character
Expressing and comparing likes, dislikes and interests
Asking about likes and dislikes
Speaking about personal relationships, the family
Adjectives to describe character, music

<u>Module III –</u> **<u>9L</u>**
Some uses of **hay**, the verb **estar**, the superlative
un / **una** / **unos** / **unas**
Quantifiers: **muy**, **mucho** / **mucha** / **muchos** / **muchas**
qué, **cuál** / **cuáles**, **cuántos** / **cuántas**, **dónde**, **cómo**

Identifying objects
Expressing needs
Shopping: asking for items, asking about prices, etc.
Talking about preferences

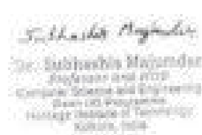
The numbers over 100
The colours, clothes, everyday objects
Demonstratives: **este** / **esta** / **estos** / **estas**, **esto**
e l/ **la** / **los** / **las** + adjective
qué + noun, **cuál** / **cuáles**
tener que + infinitive
The verb **ir**
The verb **preferir**

Module IV – **9L**

The verb **gustar**
Quantifiers (**muy**, **bastante**, **un poco**)
Possessives
también / **tampoco**

The **presente de indicativo** and some irregular verbs
Reflexive verbs
Yo también / **Yo tampoco** / **Yo sí** / **Yo no**
Primero / **Después** / **Luego**

Quantifiers (**algún**, **ningún**, **muchos**)
Prepositions and adverbs of place (**a**, **en**, **al lado de**, **lejos**, **cerca**...)
Ordering and giving information about food
Speaking about different culinary habits
Describing districts, towns and cities
Adjectives to describe a district



Suggested Reading

Corpas, Jaime. *Cuadernos de gramática española A1*. Difusion, 2010. Print.

Hanssler, William Beginners' Spanish. Forgotten Books, 2016. Print.

Jagger, Lucas. *Learn Spanish Step by Step: Spanish Language Practical Guide for Beginners*.

Ibarra, Juan Kattan. Complete Spanish Book.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

OPTION FOR FREE ELECTIVE I (Odd Semester)

MATH4181	Operation Research and Optimization techniques
MATH4182	Linear Algebra
ECEN4181	VLSI Design Automation
ECEN 4182	Control Systems
ECEN4183	Principles of Communication systems
BIOT4181	Biosensors
MECH4181	Computational Fluid Dynamics
AEIE 4182	Introduction to Embedded System

Code	Subject	Contact periods / week			Total	Credits
		L	T	P		
MATH4181	**Operations Research and Optimization Techniques**	**3**	**0**	**0**	**3**	**3**

Module- I **9 L**

Linear Programming Problem (LPP)-I

Formulation of an LPP; Graphical Method of solution of an LPP; Convex Combination and Convex Set; Convex Hull and Convex Polyhedron; Canonical and Standard form of an LPP; Basic Solution of a system of linear equations; Simplex Method; Big-M Method; Concept of Duality; Mathematical formulation of duals; Dual Simplex Method.

Module- II **9 L**

Linear Programming Problem (LPP)-II and Game Theory

Transportation Problems (TP) ; Representation of Transportation Problems as LPP; Methods of finding initial basic feasible solution of TP: North -West Corner Rule, Matrix Minima Method, Vogel's Approximation Method; Optimality test of the basic feasible solution; Assignment Problems; Hungarian Method; Travelling Salesman Problem.

Strategies; The Minimax and Maximin Criterion; Existence of Saddle Point; Games without a Saddle Point; Mixed Strategies; Symmetric Games; Dominance Principle; Two-Person Zero-Sum Game; Graphical Method of Solution; Algebraic Method of Solution.

Module- III **9 L**

Non-Linear Programming Problem (NLPP)-I

Single- variable Optimization; Multivariate Optimization with no constraints: Semidefinite Case, Saddle Point; Multivariate Optimization with Equality Constraints: Method of Lagrange Multipliers; Multivariable Optimization with inequality constraints: Kuhn-Tucker Conditions.

Dr. Subhashis Majumder

Module- IV **9 L**

Non-Linear Programming Problem (NLPP)-II

Unimodal Function; Elimination Methods: Interval Halving Method, Fibonacci Method, Golden Section Method; Interpolation Methods: Quadratic Interpolation Methods; Cubic Interpolation Method, Newton Method, Quasi- Newton Method, Secant Method.

Suggested Readings:

1. *Linear Programming and Game Theory* by J. G. Chakraborty and P. R. Ghosh, Moulik Library.
2. *Operations Research* byKanti Swarup, P. K. Gupta and Man Mohan, S. Chand and Sons.
3. *Engineering Optimization* by S. S. Rao, New Age Techno Press.
4. *Algorithms for Minimization without Derivative* byR. P. Brent,Prentice Hall.

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING, HIT

Code	Subject	Contact periods / week			Total	Credits
		L	T	P		
MATH4182	**Linear Algebra**	**3**	**0**	**0**	**3**	**3**

Course Objective:

Here are some of the objectives for studying the course:

1. Eigenvalues and eigenvectors , Diagonalizing A, computing powers Ak and Matrix Exponentials
2. Symmetric matrices and positive definite matrices
3. Generalized Inverses
4. Basis and dimension, Linear independence and Spanning Sets
5. Least squares solutions : closest line by understanding projections
6. Orthogonalization by Gram-Schmidt (factorization into A = QR)
7. Singular Value Decomposition
8. Vector spaces and subspaces
9. Linear transformations and change of basis

Prerequisites

Good understanding of Matrix Algebra as described in MATH1101

Syllabus

Module I: Characteristic Equations, Eigen Values and Eigen Vectors, Diagonalization, Applications to Differential equations, Symmetric Matrices, Positive Definite Matrices, Similar Matrices, Singular Value Decomposition, Generalized Inverses. 9L

Module II: Definition of Field, Vector Spaces, Elementary Properties in Vector Spaces, Subspaces, Linear Sum of Subspaces, Spanning Sets, Linear Dependence and Independence, Basis and Dimension. Application to matrices and system of linear equations. 9L

Module III: Inner Product Spaces, Concept of Norms, Orthogonality, Projections and subspaces, Orthogonal Complementary Subspaces, Orthogonal Projections, Gram-Schmidt Orthogonalization Process, Least square approximations, QR decomposition. 9L

Module IV: Linear Transformations, kernels and images, The Rank-Nullity-Dimension Theorem. Matrix representation of a Linear Transformation, Change of Basis, Linear space of linear mappings. 9L

Suggested Books:

1. Linear Algebra and its Applications: Gilbert Strang (Thomson Brooks/Cole Cengage Learning)
2. Matrix Computations : Gene H. Golub, Charles F. Van Loan (JHU Press)
3. Linear Algebra : Kenneth M. Hoffman, Ray Kunze (Prentice-Hall)
4. Linear Algebra A Geometric Approach: S. Kumaresan (PHI)

Paper Name: **Advanced Probability and Statistics (B. Tech. Open Elective)**					
Paper Code: **MATH 4281**					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

Module - I: Probability-I (Single variable probability distributions)

- Review of basic probability : Axiomatic definition, Addition and Multiplication law
- Conditional probability and Bayes' Theorem
- Transformation of random variables
- Expectation and Variance of single variable discrete and continuous distributions
- Normal approximation to Binomial and Poisson Distribution
- Exponential family of distributions and Multinomial Distribution

Module-II: Probability-II (Limit theorems and Joint Distribution)

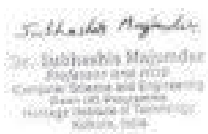
- Moment generating and characteristic functions
- Limit theorems: Markov's inequality and Chebyshev's inequality with examples
- Joint distribution using joint probability mass/density function
- Finding marginal pmf/pdf from joint distribution
- Multiplicative property of joint pmf/pdf in case of independent random variables

Module-III: Statistics-I

- Moments, Skewness and Kurtosis
- Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions using moment generating functions
- Covariance, Correlation and Regression
- Curve fitting: Straight line and parabolas

Module-IV: Statistics-II

- Population and Samples
- The sampling distribution of mean (σ known)
- The sampling distribution of mean (σ unknown)
- Point and Interval estimation, Maximum Likelihood Estimation
- Tests of Hypotheses,Null Hypotheses and Tests of Hypotheses with simple examples



Suggested Books:

1. Probability and Statistics for Engineers , *Richard A Johnson*, Pearson Education
2. Groundwork of Mathematical Probability and Statistics, *Amritava Gupta*, Academic Publishers
3. Introduction to Probability Models, *S.M.Ross*, Elsevier
4. Fundamentals of Mathematical Statistics, *S.C.Gupta and V.K.Kapoor*, Sultan Chand and Sons
5. An Introduction to Probability theory and its applications Vol-I, *W. Feller*, John Wiley and Sons

Paper Name: **Advanced Computational Mathematics and Graph Theory** **(B. Tech. Open Elective)**					
Paper Code: **MATH 4282**					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

Module 1: Sums : Sums and recurrences, manipulation of sums, multiple sums, general methods, finite and infinite calculus, infinite sums 9L

Module 2: Binomial coefficients, generating functions and special numbers: Basic identities, generating functions, special numbers: Bernoulli numbers, Euler numbers, harmonic numbers, Fibonacci numbers, recurrences. 9L

Module 3: Integer functions and arithmetic: Floors and ceilings, the binary operation 'mod', divisibility, primes, relative primality, the congruence relation 'mod', residues, Euler phi function, Fermat's Little Theorem, Wilson Theorem, primitive roots, the law of quadratic reciprocity, (Statement only). 9L

Module 4: Graph Theory: Trees, spanning trees, shortest paths, vertex connectivity, edge connectivity, cuts, matchings, maximum matchings, independent sets, graph colouring, chromatic numbers, chromatic polynomials 9L

References:

1. Ronald Graham, Donald Knuth, Oren Patashnik, 'Concrete Mathematics', Addison-Wesley
2. Douglas B. West, 'Introduction to Graph Theory', Pearson

4th Year 1st Semester

Course Name : POWER PLANT ENGINEERING					
Course Code: MECH 4101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After going through the course, the students will be able to:

CO1: **Identify** sources of energy and the types of power plants that are in operation in the world, **List** their advantages and disadvantages with respect to cost of power generation and pollution.

CO2: **Analyze** and evaluate different types of thermodynamic cycles (Reheat cycle, Regenerative cycle, Dual cycle , Combined Heat and Power Cycle) used in thermal power plants and **List** their advantages and disadvantages.

CO3: **Compare** between Impulse and Reaction turbine , **Analyze** the work output and efficiency of Impulse and Reaction Turbine , **List** the advantages and disadvantages of pressure compounding and velocity compounding , **Explain** the need of Governing of steam turbine .

CO4 : **Calculate** the chimney height and diameter , **Draw up** a heat balance sheet of a boiler and Compute the boiler efficiency.

CO5 : **Assess** the operating efficiency of various power plants based on their load factor, diversity factor, capacity factor, **Understand** the economics of setting up of power plants, **Compare** the cost of power generation by various power plants,Analyse the surface condensers used in power plants.

CO 6 : **Understand** the importance of coal and ash handling system, **Analyse** the coal on proximate and ultimate analysis method, **Devise** methods to curb emission of pollutants to atmosphere.

Module No.	Syllabus	Contact Hrs.
Module 1	Review of fundamentals; Power plant cycles - Rankine, Reheat, regenerative cycles; Binary vapour and co-generation; Introduction to Boilers: Fire tube and water tube boilers, mountings and accessories, Super-critical boilers.	1 3 3 2
Module 2	Draft in boilers- natural, induced, forced and balanced; Chimney height, power requirement of fans. Performance of boilers - equivalent evaporation, boiler efficiency, losses in boilers and heat balance. Coal combustion- properties of coal, ultimate analysis, proximate analysis, combustion calculations, Coal and ash handling system.	3 3 3

Module 3	Steam turbines- parts and classification, nozzle types, flow through nozzles, condition for maximum flow rate, nozzle efficiency.	3
	Impulse turbine- velocity diagram, work done and blade efficiency. Condition for maximum blading efficiency. Pressure compounding or Rateau Turbine and velocity compounding or Curtis Turbine of steam turbine. Impulse, reaction turbine- velocity diagram, degree of reaction. Parsons turbine: condition for maximum blading efficiency. Governing in steam turbines.	6
Module 4	Condensing systems- basic ideas. Classification of steam condensers. Leakage in condensers, condensing efficiency, Cooling Tower –Dry cooling tower and Wet cooling tower; Cooling tower calculations.	4
	Power plant economics: load curve and various factors, cost of power generation.	3
	Introduction to nuclear and hydel power plants.	2
	Total	**36**

Text Books:

1. Power Plant Engineering - 4e, Nag, P. K. – TMH.
2. Thermal Engineering- 8e, R. K. Rajput, Laxmi Publication (P) Ltd

Reference Books:

1. Thermal Engineering- 24e, B. L. Ballaney, Khanna Publishers
2. Power Plant Engineering -8e, Domkundwar- Arora- Domkundwar, Dhanpat Rai & Co.
3. Powerplant Technology, M. M. El-Wakil, Tata McGraw-Hill Education
4. Power Station Engineering and Economy, William A. Vopat, Tata McGraw-Hill Education

09/08/2022

Course Name : ADVANCED MANUFACTURING TECHNOLOGY					
Course Code: MECH 4102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Acquire working knowledge on computer integration with mechanical systems.
CO 2	Learn about computer aided design, manufacturing, process planning and quality control.
CO 3	Form basic ideas on cellular, flexible manufacturing system and automated material handling, storage, retrieval system.
CO 4	Understand reverse engineering, group technology, rapid prototyping, high speed machining and solid modeling techniques.
CO 5	Learn various non-traditional machining processes and their application.
CO 6	Familiarization with the high energy rate forming processes.

Module No.	Syllabus	Contact Hrs.
Module 1	**MODULE: 1A** Introduction to CAD/CAM/CAE, Solid modeling concepts, Computers in design, computers in Manufacturing, CNC/DNC, Cellular Manufacturing, Flexible Manufacturing System (FMS), Intelligent Manufacturing System. **MODULE: 1B** Computer Integrated Manufacturing (CIM), Computer Networking, Robots in Manufacturing, Palletized Material Handling, Automated Guided Vehicle (AGV), Automated Storage & Retrieval System (AS/RS).	6 6
Module 2	**MODULE: 2A** Group Technology Concept (GT), Classification & Coding system, Computer Aided Process Planning (CAPP), Computer Aided Quality Control (CAQC), Co-ordinate Measuring Machine (CMM) **MODULE: 2B** Modern Cutting Tools, High Speed Machining Reverse Engineering, Rapid Prototyping & Tooling	6 2 4

Module 3	Introduction to Non-Traditional Machining (NTM) Processes: USM, AJM, WJM, ECM, EDM, PAM, LBM, EBM	14
Module 4	**MODULE: 4A** Comparison between different NTM processes for MRR, Surface finish & Accuracy; Electro-Thermal Energy Processes- PAM, LBM, EBM, IBM; **MODULE: 4B** High Energy Rate Process - Explosive forming, Electro-Magnetic Forming, Electro-Hydraulic Forming.	4 6
	Total	**48**

Text Books:
1. CAD/CAM, P. N. Rao, TMH
2. CAD/CAM, M.P.Groover and E.W.Zimmers, Prentice Hall of India.
3. Manufacturing Technology, Kalpakjian, Pearsons Publications.
4. Non-conventional Machining, P.K.Mishra, Narosa Publishers

Reference Books:
1. Manufacturing Engineering & Technology, K. Jain, Pearson Education
2. Manufacturing Technology, Radhakrishnan, Scitech
3. Manufacturing Science, Ghosh & Mallik, Affiliated East-West Press Pvt. Ltd.

09/08/2022

Course Name : OPERATIONS RESEARCH					
Course Code: MECH 4103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	**Interpret** the basic idea, history and different applications of operations research in engineering as well as managerial fields.
CO 2	**Formulate** different decision making problems and **argue** for solving them with different techniques .
CO 3	**Illustrate** different network models and **estimate** about project scheduling and completions.
CO 4	**Identify** different transportation and assignment problems and **optimize** them as necessary.
CO 5	**Differentiate** between different waiting line models and **Construct** problem statement and **analyze** them for better outcomes.
CO 6	**Distinguish** between LPP and NLPP problems and **apply** different techniques for **Developing** their solutions .

Module No.	Syllabus	Contact Hrs.
Module 1	**Introduction**: Brief history of OR; Introduction to different OR problems: Decision Theory, Linear Programming, Transportation and Assignment problems, Network Analysis (CPM/ PERT), Integer Programming, Non-linear Programming, Queuing or Waiting line problems. **Decision Theory**: Decision making under certainty, risk and uncertainty, Multi-criteria decision making (MCDM) problems. **Network Analysis**: Network models and terminologies, shortest path/route problem; The minimum spanning tree problem; The maximal flow problem.	**2** **4** **3**
Module 2	**Transportation Problems:** Tabular representation of a transportation problem; North-West corner initial solution; stepping stone method; concept of dummy source or destination; Vogel's approximation method. **Assignment Problems:** Hungarian method for solving Assignment problems.	**3** **2**

	Linear Programming Problem (LPP): Nature of LPP through examples; General form of LP model; Formulation of LPP; Graphical solutions; Simplex method, Duality in LPP, Sensitivity analysis.	**6**
Module 3	**Waiting Line Problems:** Structure of a waiting line system; single-channel waiting line; process of arrivals; distribution of service times, queue discipline, steady stage operation; single channel model with Poisson arrivals and exponential service time; Multiple channel model with Poisson arrivals and arbitrary service. time (M/G/I); Economic analysis of waiting lines	**7**
Module 4	**Non-Linear Programming:** Graphical illustration of a non-linear programming; Unconstrained optimization by (i) direct search method (ii) steepest decent method, constrained optimization by Lagrange multipliers; Integer linear programming by branch & bound techniques; Dynamic programming problems and their characteristics, Bellman's principle of optimality; solving (i) Stagecoach problem (ii) Knapsack problem.	**9**
	Total	**36**

Text Books:

1. Quantitative Techniques in Management, N. D. Vohra, Mc-Graw Hill.
2. Operations Research, V.K.Kapoor, Sultan Chand & Sons.
3. Operations Research, Hira and Gupta, S Chand & Co.

Recommended Books:

1. Operations Research: An Introduction, H. A. Taha, PHI Pub.
2. Principles of Operation Research, Wagner, PHI Pub.

09/08/2022

Course Name : IC ENGINE LAB					
Course Code: MECH 4111					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

After going through the course, students will be able to:

- **Describe** the working principles of 2/4-stroke SI/CI engines through models (**L2**).
- **Define** and calculate the calorific value of a fuel by Bomb calorimeter (**L1**).
- **Explain** the implication of opening and closing of valves on engine performance through the valve timing diagram (**L2**).
- **Analyze** the performance $(IHP, BHP, FHP, bsfc, \eta_{vol}, etc.)$ of CI/SI Engines through various experiments using various dynamometer arrangements (**L4**).
- **Analyze** flue gas composition by the ORSAT apparatus (**L4**).
- **List** the different components of the MPFI (multipoint fuel injection) system through a model (**L1**).

Sl. No.	List of Experiments	Contact Hrs.
Expt 1	Familiarization with different components of an I C Engine.	3
Expt 2	Determination of calorific value of a fuel by Bomb calorimeter.	3
Expt 3	Study of valve timing diagram of a Petrol Engine.	3
Expt 4	Performance Test of a C I Engine using electric (eddy current). dynamometer.	3
Expt 5	Performance Test of a multi-cylinder S I Engine by Morse Test.	3
Expt 6	Flue gas analysis by ORSAT apparatus.	3
Expt 7	Use of catalylitic converter and its effect on flue gas of a CI Engine (Analysis to be done by ORSAT apparatus).	3
Expt 8	Study of MPFI (multipoint fuel injection system). (Demonstration only)	3
	Viva-voce	

N B: At least 6 experiments are to be performed.

09/08/2022

Course Name : MACHINING AND MACHINE TOOLS LAB					
Course Code: MECH 4112					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Course Outcomes:

After completion of the course, students will be able to:

- Select appropriate cutting process parameters for a particular machining operation.
- Analyze mechanism of chip formation in turning operation.
- Learn basic principle of tool-wear and evaluate of tool life.
- Produce a Helical gear.
- Design speed structure and construct Ray Diagram of an all-gear headstock Lathe.
- Analyze Apron Mechanism of a Centre lathe and Quick-return mechanism & stroke length adjustment of a Shaping Machine.

Sl. No.	List of Experiments	Contact Hrs.
Expt 1	**Machine Tool:** Study of speed structure & construction of Ray Diagram of an all gear headstock Lathe.	3
Expt 2	**Machine Tool:** Study of Apron Mechanism of a Centre / Engine Lathe.	3
Expt 3	**Machine Tool:** Study Quick-return mechanism and stroke length adjustment of a Shaper Machine.	3
Expt 4	**Machine Tool:** Study of spindle rotation and table feed system of a Milling Machine.	3
Expt 5	**Machining:** Measurement of cutting forces in straight turning at different feeds and speeds.	3
Expt 6	**Machining:** Study of chip formation (type, color and thickness) in turning mild steel and evaluation of role of variation of cutting speed and feed on chip reduction coefficient / cutting ratio and shear angle.	3
Expt 7	**Machining:** Measurement of tool-wear and evaluation of tool life in turning mild steel by HSS.	3
Expt 8	**Machining:** Production of a Helical gear from a cast or forged disc.	3
	Viva-voce	

N B: At least 6 experiments are to be performed.

Course Name : INDUSTRIAL TRAINING EVALUATION					
Course Code: MECH 4131					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
					2

Course Outcomes:

CO1	Get an idea of industrial set up and its associated complexity
CO2	Evaluate the classroom knowledge against the real life application
CO3	Learn the sequence of activities that lead to a finished product from the raw material
CO4	Learn about activities other than design and manufacturing that are necessary for producing the goods and services
CO5	Develop the ability to identify problems when a process does not deliver the planned output
CO6	Develop ability to write report on an observed process

This is a compulsory industrial training of 4 weeks duration, which all the students have to undergo at the end of 6th semester. Individual student has to submit a bound report along with the training certificate within a specified date and as per specified format which will be notified by the department.

All the students have to undergo a viva-voce examination to establish 6 actual outcome of the training undergone.

09/08/2022

Course Name : COMPUTATIONAL METHODS IN ENGINEERING					
Course Code: MECH 4142					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to-

CO1: Identify suitable engineering problems and formulate the computational framework.
CO2: Learn the method of approximation and ascertain validity of the results.
CO3: Formulate the linear algebraic equations and solve them by elimination and iteration methods.
CO4: Apply the regression and interpolation methods for curve fitting.
CO5: Identify and apply different numerical integration methods of solution and solve eigen value problems.
CO6: Apply the finite difference method to solve one-dimensional and two-dimensional problems.

Module No.	Syllabus	Contact Hrs.
Module 1	Simple Mathematical model of engineering problem, Conservation Laws in Engineering.	2
	Approximations– Significant figures, Accuracy, Precision & Error; definition and formulations. Round-off and truncation errors, error propagation.	4
	Formulation and solution of linear algebraic equations, Gauss elimination, LU decomposition.	3
Module 2	Solution of linear algebraic equations through iteration methods, convergence.	2
	Linear and polynomial regression, multiple linear regression, general linear least squares.	4
	Interpolation methods: Newton's divided difference interpolation of polynomials, Lagrange interpolation of polynomials.	3
Module 3	Numerical Integration: The Trapezoidal rule, Simpson's rule, Gauss quadrature.	5
	Initial and boundary value problems, Eigen value problems- applied to a physical system.	4
Module 4	Finite difference method and application in mechanical engineering.	3
	Simple one dimensional steady state problems and solution techniques. Nodal network in two dimensions, Finite difference form, Solution procedure for finite difference equations.	6
	Total	**36**

Text Books:

1. Numerical Methods for engineers, Steven C Chapra & Raymond P. Canale, McGraw-Hill
2. Numerical Analysis, P Sivaramakrishna Das and C Vijaykumari, Pearson Education
3. Computational Methods in Engineering, S.P. Venkateshan and Prasanna Swaminathan, Academic Press

Reference Books:

1. Numerical Methods for Engineers, S K Gupta, New Age International
2. Principles of Heat and Mass Transfer, F P Incropera & D P Dewitt, Wiley

09/08/2022

Course Name : QUANTITY PRODUCTION METHOD					
Course Code: MECH 4143					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After going through the course, students will be able to:

CO 1	Acquire knowledge of various mass manufacturing processes.
CO 2	Apply mass manufacturing knowledge for manufacturing common engineering items.
CO 3	Apply different production process knowledge for manufacture of engine components
CO 4	Improve productivity and quality through application of planning, group technology and quality control.
CO 5	Improve productivity through application of robots and CNC machines in production
CO 6	Learn various non-conventional and emerging production techniques like powder metallurgy

Module No.	Syllabus	Contact Hrs.
Module 1	Genesis of production of goods; Engineering Production: Definition, aims and objectives. Levels of production; job, batch, lot, mass and quantity production. Mechanization and need, degree and types of automation. Role of automation in industrial production. Broad classification of engineering production methods. Major sequential steps in industrial production: pre-forming, semi-finishing, heat treatment, finishing, assembly and inspection. Quantity production by spinning, bulging, magneto forming, hydro forming, explosive forming.	**8**
Module 2	Quantity production of common items: Shafts and spindles. Gears and bearings. Bolts and nuts. Automobile parts: Engine block, crank shaft, etc. Quantity produced small engineering products like washers, pins, etc.	**10**
Module 3	Process planning & scheduling for quantity production with semi-automatic and automatic lathes, Transfer machines. CNC machining systems (including machining centre, FMS). Design and use of jigs and fixtures for batch production in machine shops. Group Technology: concept and application in large scale production.	**10**

	Inspection and quality control in quantity production	
Module 4	Application of Computer and Robot in quantity production. Production of tool inserts by powder metallurgical process. Quantity production of ceramic and polymer products.	**8**
	Total	**36**

Text Books:

1. Manufacturing Processes for Engineering Materials, Serope Kalpakjian and Steven R. Schmidt- Pearson.
2. Process and Materials for Manufacture, R. A. Lindberg, Prentice Hall.

Reference Books:

1. Fundamentals of modern manufacturing, M. P. Groover, Wiley.

09/08/2022

Free Electives offered by ME dept. for other departments

Course Name : QUANTITATIVE DECISION MAKING					
Course Code: MECH 4181					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	**Understand** the meaning and appreciate importance of Quantitative Decision Making.
CO 2	**Recognize** different conditions and **implement** different decision making tool to take decisions under certain conditions
CO 3	**Understand, Formulate** and **solve** mathematical model (linear programming problem) for a physical situations like production, distribution of goods and economics
CO 4	**Solve** the problems for transporting products from origin to destination with least transportation cost.
CO 5	**Identify** the resources required for a project and generate a plan and work schedule
CO 6	**Understand** and **solve** the practical situations into non-linear programming problem

Module No.	Syllabus	Contact Hrs.
Module 1	**Introduction**: Brief history of OR; Introduction to different quantitative decision making (QDM) problems: Decision Theory, Linear Programming, Transportation and Assignment problems, Network Analysis, Scheduling by CPM, Inventory models, Integer Programming, Non-linear Programming, Dynamic Programming.	**2**
	Decision Theory: Decision making under certainty, risk and uncertainty.	**3**
	Network Analysis: Network models and terminologies, shortest path/route problem; The minimum spanning tree problem; The maximal flow problem.	**3**
Module 2	**Transportation Problems:** Tabular representation of a transportation problem; North-West corner initial solution; stepping stone method; concept of dummy source or destination; Vogel's approximation method.	**3**

05/08/2022

	Linear Programming Problem (LPP): Nature of LPP through examples; General form of LP model; Formulation of LPP; Graphical solutions; Simplex method, Duality in LPP, Sensitivity analysis.	**7**
Module 3	**Assignment Problems:** Hungarian method for solving Assignment problems. **Scheduling:** Project scheduling, Network construction, Critical path method-computation of float and slack, determination of critical path and time; Crashing of network; Resource leveling process.	**2** **7**
Module 4	**Non-Linear Programming:** Graphical illustration of a non-linear programming; Unconstrained optimization by (i) direct search method (ii) steepest decent method, constrained optimization by Lagrange multipliers; Integer linear programming by branch & bound techniques; Dynamic programming problems and their characteristics, Bellman's principle of optimality; solving (i) Stagecoach problem (ii) Knapsack problem.	**9**
	Total	**36**

Text Books:

1. Quantitative Techniques in Management, N. D. Vohra, Mc-Graw Hill.
2. Operations Research, V.K.Kapoor, Sultan Chand & Sons.
3. Operations Research, Hira and Gupta, S Chand & Co.

Recommended Books:

1. Operations Research: An Introduction, H. A. Taha, PHI Pub.
2. Principles of Operation Research, Wagner, PHI Pub.

Course Name : PROJECT-I					
Course Code: MECH 4191					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**6**	**6**	**4**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	Demonstrate application of sound technical knowledge on their selected project topic.
CO 2	Undertake problem identification, formulation and solution.
CO 3	Design engineering solutions to complex problems utilising a system approach or design experimental set up or conduct literature survey for analytical models.
CO 4	Prepare manufacturing drawings to show design outcome for a product/ experimental set up or assimilation of knowledge for developing analytical models.
CO 5	Communicate with engineers and the community at large in written and oral forms.
CO 6	Demonstrate the knowledge, skills and attitudes of a professional engineer.

This is a sessional course work. Students in a group of maximum six (6) will do a project work under one specified faculty member, over two semesters, 7th and 8th. The topics of the projects will be selected by the department and will be allotted to the students as per merit.
Under Part-I in 7th semester the scope will be complete design of the project, determination of methodology for doing the project and preparation of manufacturing drawings, etc. to be completed. There will be one mid semester and one end semester viva voce examination in front of a team of faculty members for evaluation of the project work. The group has to submit bound report on the outcome of the project work.

09/08/2022

Course Name : ADVANCED MANUFACTURING LAB					
Course Code: MECH 4211					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	2

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Operate a CNC lathe using control panel.
CO 2	Program a CNC Lathe based on a component drawing, test the program and produce the component in automatic cycle.
CO 3	Operate an EDM machine using control panel.
CO 4	Program an EDM machine based on a component drawing and produce the Component in automatic cycle.
CO 5	Understand a robot and its subsystems.
CO 6	Write a program and run the robot on automatic mode for performing specified task.

Sl. No.	List of Experiments
1	Study of CNC Lathe and its subsystems.
2	Basic Operations of CNC Lathe like homing, slide movements, spindle rotation, turret indexing, coolant on-off, tool offset, program editing and dry run.
3	CNC programming for operations like Facing, Chamfering & Turning.
4	CNC programming for Stock Removal, Radius Turning and Thread cutting.
5	Study of EDM machine and its subsystems.

6	Basic operations of EDM machine like tool setting, job setting and setting machining parameters.
7	Machining of a component in EDM and calculate its material removal rate.
8	Study of robot and its subsystems. Basic Robot operations like homing, arm movement and gripper operation.
9	Programming a robot for autonomous pick and place operation.
10	Marking & drilling holes in a plate using radial drilling machine.

N.B: A minimum of six experiments must be performed in the semester, covering at least two for each of the three machines.

09/08/2022

<table>
<tr><td colspan="6">Course Name : DESIGN OF AN INDUSTRIAL PRODUCT</td></tr>
<tr><td colspan="6">Course Code: MECH 4221</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit points</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>4</td><td>2</td></tr>
</table>

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	Define specification of an industrial product or mechanical system
CO 2	Gather knowledge on the construction and working of the product/ system from various sources through literature study, industry visit etc.
CO 3	Identify sub-assemblies and components that will go into designing the product/ system
CO 4	Apply engineering knowledge to design the components and the final product and evaluate its performance
CO 5	Develop manufacturing drawings of the components and General Assembly drawing of the complete product/ system along with its Bill of Material
CO 6	Defend the design during its scrutiny by a panel of faculty

This is a sessional course work. Students in a group of around 10 will undertake this course under one faculty guide. Each group will be asked to design a mechanical equipment/system. The group has to work out the design of the unit and then make proper engineering drawing for the same. The drawings should include GA drawing with BOM and detailed drawings for parts/components.

The course work will be examined by a group of faculty members in which the design guide will be a member.

09/08/2022

Course Name : COMPREHENSIVE VIVA VOCE					
Course Code: MECH 4231					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
					3

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Learn the art of making oneself presentable to a panel/board of unknown people.
CO 2	Apply the basic knowledge of engineering, science and others studied during the course to respond to questions.
CO 3	Acquire skills to face and interact with a panel of interviewers and express his/her ideas with confidence.
CO 4	Enhance the capabilities of independent thinking with reasoning.
CO 5	Develop the abilities to respond to questions by using the knowledge of apparently independent subjects.
CO 6	To switch concentration from one topic to another completely differently topic for a quick response.

This viva voce examination will be conducted at the later part of 8th semester. Each student will appear in the test at the prefixed time and date.

This will be an evaluation of the student's overall mechanical engineering concept and grasp of all the 8 semester courses undertaken by the student.

09/08/2022

Free Electives offered by ME dept. for other departments

Course Name : MECHANICAL HANDLING OF MATERIALS					
Course Code: MECH 4281					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Interpret the importance of materials handling (UNDERSTAND)
CO 2	Identify the application of different types of materials handling systems and equipments (REMEBERING)
CO 3	Implement the concept of maximizing productivity for designing of effective materials handling system (APPLY)
CO 4	Infer suitable materials handling equipment for specific applications (ANALYZE)
CO 5	Evaluate alternative or innovative solutions, concepts and procedures for effective utilization of materials handling equipments (EVALUATE)
CO 6	Develop specific conveying equipment for designated bulk material handling systems (CREATE)

Module	Syllabus	Contact Hrs.
1	**Introduction :** Definition, importance and scope of materials handling (MH); Objectives of Material Handling; classification of materials; utility of following principles of MH – (i) materials flow, (ii) simplification, (iii) gravity, (iv) space utilization, (v) unit size, (vi) safety, (vii) standardization, (viii) dead-weight, (ix) idle time (x) motion. **Load Unitization:** Definition; advantages & disadvantages of unitization; unitization by use of platform, container, rack, sheet, bag and self contained unit load; descriptive specification and use of pallets, skids, containers, boxes, crates and cartons; shrink and stretch wrapping. **Classification of MH Equipment :** Types of equipment – (i) industrial trucks & vehicles, (ii) conveyors, (iii) hoisting equipment, (iv) auxiliary equipment; Independent equipment wise sub classification of each of above type of equipment.	9
2	**Conveyors :** Use and characteristics of belt conveyor, constructional features of flat and troughed belt conveyor; Use and constructional features of Flg. types of chain conveyors – apron, car and trolley type; Construction of link-plate chains; Dynamic phenomena in chain drive; Use and constructional features of roller conveyors; Gravity and powered roller conveyor; Pneumatic conveyor-use and advantages; Positive, negative and combination system of pneumatic conveyors; constructional feature, application and conveying	10

	capacity of screw conveyor, bucket elevator.	
3	**Hoisting Equipment:** Advantage of using steel wire rope over chain; constructional features of wire ropes; Rope drum design; Pulley system-simple vs. multiple pulley; Load handling attachments : hooks, grabs, tongs, grab bucket; Use and constructional features of (i) hand operated trolley hoist, (ii) winch; (iii) Jib crane, (iv) overhead traveling crane and (v) wharf crane; Level luffing system of a wharf crane; Utility of truck mounted and crawler crane.	8
4	**Ttrucks & Vehicles:** Constructional features and use of the equipment: (i) wheeled hand truck, (ii) hand pallet truck, (iii) fork lift truck; Major specifications, capacity rating and attachments of fork lift truck ; FLT batteries. **Auxiliary Handling Equipment :** Descriptive specification and use of – (i) Slide and trough gates, (ii) belt, screw and vibratory feeders, (iii) Chutes, (iv) positioners like elevating platform, ramps, universal vise; (v) ball table.	9
	Total Classes	**36**

Books Recommended:

1. Introduction to Materials Handling- S. Ray, New Age Int. Pub.
2. Materials Handling: Principles and Practices- T.H. Allegri, CBS Publishers and Distributors.
3. Mechanical Handling of Materials- T. K. Ray, Asian Books Pvt. Ltd.

Course Name : AERODYNAMICS					
Course Code: MECH 4282					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completion of the course, students will be able to:

- Learn fundamental physical and analytical principles of aerodynamics.
- Use the fundamental laws to solve problems in aerodynamic applications.
- Solve standard bench mark problems like vortex flow, Stokes theory etc.
- Analyze the effect of drag and lift force on submerged bodies.
- Apply the knowledge of aerodynamics in design of turbo-machine blades, vehicles etc.

Module No.	Syllabus	Contact Hrs.
Module 1	Introduction: definition, historical development, classification & practical objectives, some fundamental aerodynamic variables, Aerodynamic forces & moments, centre of pressure, dimensional analysis and flow similarity, Mach number regimes, Kinematics of gas flow: equation of motion, circulation, Stokes theory, stream function and velocity potential.	9
Module 2	Vortex motion: vortex tube, vortex sheet, Biot-Savart law, Kelvin's theorem, vortex theorems of Helmboltz, Combination of basic flow patterns: lift on a rotating cylinder, Magnus effect, Joukowski's transformation.	9
Module 3	Lift on an aerofoil: aerodynamic forces on a lifting surface; nomenclature and shape of aerofoils; lift and drag coefficients of aerofoils; circulation theory of lift; effect of wave on lift. Thin aerofoil theory and its application; finite span effects; induced drag. Drag on an aerofoil: effect of viscosity, skin friction and forms drag; flow separation and stalling; boundary layer control and its effect.	9
Module 4	Effects of compressibility: shock waves on wings and bodies; effect of sweep on two-dimensional wings. Application of the knowledge of aerodynamics in the design of turbo-machine blades, streamlining vehicle structures, reducing wind-load on buildings and structures etc.	9
	Total	**36**

Text Books:

1. Fundamentals of Aerodynamics, John D. Anderson, Jr., Mc-Graw Hill, 3e.
2. Foundations of Aerodynamics: Bases of Aerodynamics Design, Arnold M. Kuethe and Chuen-Yen Chow, Wiley India Pvt. Ltd.

Reference books:

1. Theoretical Aerodynamics, L. M. Milne-Thomson, Dover Pub.

09/08/2022

Course Name : **COMPUTATIONAL FLUID DYNAMICS**					
Course Code: MECH 4144					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of the course, a student will be able to	
CO 1	Memorize fundamental laws of fluid dynamics.
CO 2	Interpret the fundamental conservation laws of fluid flow in differential form.
CO 3	Apply discretization techniques on governing differential equations.
CO 4	Examine the solutions of simple convection and diffusion problems using different CFD algorithms.
CO 5	Evaluate the applicability of different CFD solution techniques.
CO 6	Start investigating fluid flow problems using CFD software.

Module No.	Syllabus	Contact Hrs.
Module 1	Introduction, Control Volume, Eulerian & Lagrangian frame. Substantial, Temporal and Convective derivatives, Examples. Equations of state, Conservation laws for fluid motion (mass, momentum and energy conservation equations). Navier-Stokes equations for Newtonian fluid. General transport equations (Differential & Integral forms).	**1** **1** **4** **1** **2**
Module 2	Time averaged Navier-Stokes equations for Turbulent flow, Turbulence models (brief idea). Different differencing schemes (Upwind, Central, Power law). Finite volume method for steady state:- (a) Diffusion (b) Convection-Diffusion problems.	**2** **2** **5**
Module 3	Pressure-Velocity coupling for steady flow- Staggered grid and Momentum equation, SIMPLE Algorithm SIMPLER Algorithm Explicit and Implicit methods.	**4** **2** **2** **2**
Module 4	Solution of discretized equations: TDMA, Boundary conditions; problem solving. CFD Software, Pre-processor (Grid Generation, Grid topology), Processor, and Post-processor.	**5** **3**
	Total	**36**

Text Books:

1. Computational Fluid Dynamics: The finite volume approach, H. K. Versteeg & W. Malalasekara, Pearson Pub.
2. Computational Fluid Dynamics: the basics with applications, Jr. John D. Anderson, McGraw Hill.

Reference Books:

1. Numerical Heat Transfer and Fluid Flow, Suhas V Patankar, Taylor & Francis
2. Computational Fluid Dynamics, John Wendt, Springer-Verlag Berlin Heidelberg

09/08/2022

Course Name : PROJECT –II					
Course Code: MECH 4291					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**12**	**12**	**8**

<u>Course Outcomes:</u>

At the end of the course, a student will be able to	
CO 1	Demonstrate application of sound technical knowledge on their selected project topic.
CO 2	Conduct project planning for an engineering project/ experimental set up or developing analytical model.
CO 3	Prepare process plan for manufacturing of parts/components or conduct experiments or perform model analysis.
CO 4	Carry out assembly to develop a prototype/working model or experimental analysis or simulation study.
CO 5	Communicate with engineers and the community at large about project outcome in written and oral forms.
CO 6	Demonstrate the knowledge, skills and attitudes of a professional engineer.

This is continuation of the project -I undertaken by the groups of students in 7^{th} semester.

In this semester, depending on the nature of the project, fabrication/manufacturing/analytical model has to be completed; experimentation/analysis to be done, results to be obtained and conclusion to be drawn. At the end of the project, the final project report as per specified format has to be submitted to the project guide. The project will be evaluated by a team of faculty members & at least one outside academic/industry expert.

09/08/2022

Subject Name: WATER RESOURCES ENGINEERING

Subject Code: CIVL 4101

Contacts: 3 L + 1 T

Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Understand the design of water resources systems utilizing the basic principles of the hydrologic cycle and the watershed.
2. The concepts of movement of ground water beneath the earth.
3. Understand the value of probability and statistical analysis in deriving precipitation and stream flow data and hydrograph theories.
4. To impart the knowledge of irrigation techniques, efficiencies, optimal irrigation of the fields, consumptive water requirements of the crops and crop types.
5. Distribution systems for canal irrigation and the basics of design of unlined and lined irrigation canals system.
6. Master the concept of water logging and drainage systems.

SL No.	Module	Details of Course Contents	Hours	Total
1	I	Catchment area and Hydrologic cycle, Measurement of rainfall – Rain gauges, Estimation of missing rainfall data, checking of consistency, Optimum number of Rain gauges. Calculation of average rainfall over area – different methods, Frequency analysis of rainfall intensity duration curve. Rainfall mass curve, hyetograph, Examples.	4	36
		Evaporation, evapo-transpiration and infiltration: Processes, Factors affecting run off, estimation of run-off, rainfall run off relationship.	4	
2	II	Stream flow measurement: Direct and indirect methods, Examples. Stage discharge relationships, back water effect, unsteady flow effect.	4	
		Hydrographs; characteristics: Base flow separation. Unit Hydrographs. Derivation of unit hydrographs, S-curve.	4	
		Types of Irrigation systems, methods of irrigation: Water requirements of crops: Crop period or Base period, Duty & Delta of a crop, relation between Duty & Delta, Duty at various places, flow Duty & quantity Duty, factors affecting Duty, measures for improving Duty of water, crop seasons	4	

3	III	Canal Irrigation: Introduction, classification of irrigation canals, Efficient section, certain important definitions, Time factor, Capacity factor, full supply coefficient, Nominal duty, Channel losses, Examples.	10	
4	IV	Water logging and drainage: Causes, effects and prevention of waterlogging. Type of drains-open drains and closed drains (introduction only), Discharge and spacing of closed drains. Examples.	6	

RECOMMENDED BOOKS:

SL. No.	Name of Text and Reference books	Author	Publishers
1	Engineering Hydrology	K. Subramanya	Tata McGraw-Hill
2	A Text Book of Hydrology	P. Jaya Ram Reddy	Laxmi Publications-New Delhi
3	Irrigation, Water Resource & Water Power Engineering	Dr. P.N Modi	Standard Book House-New Delhi
4	Irrigation and Water Resources Engineering	G.L. Asawa,	New Age International Publishers, New Delhi (2005)

Subject Name: ADVANCED STRUCTURAL ANALYSIS

Subject Code: CIVL 4141

Contacts: 3 L + 1 T

Credit: 3

Course Outcome:

1. Basic Knowledge of the student will increase.
2. Student will be able to apply stiffness and flexibility method using system approach.
3. Student will understand the yield conditions from their knowledge of stress-strain relations.
4. Student will be able to solve simple plate and shell problems.

SL No.	Module	Details of Course Contents	Contact hours	Total
1.	I	Matrix methods of structural analysis: Application of matrix methods to plane truss, beams, continuous frames.	12	42
2.	II	Finite difference and relaxation technique-application to simple problems.	10	
3.	III	Theory of plate bending: Navier's Sol utions. Levy's solution. Plate buckling problem. Membrane theory of domes and cylindrical shells.	10	
4.	IV	Theory of Elasticity: Three dimensional stress and strain analysis, stress strain transformation, stress invariants, equllibrium and compatibility equations. Two dimensional problems in Cartesian and polar coordinates. Plane stress, plane stain problems, St. Venant's principle.	10	

References:

1. Matrix, finite element, computer and structural analysis, M. Mukhopadhyay, ANE Books.
2. Intermediate Structural analysis, C. K. Wang, Mc-Graw Hill
3. Matrix method of Structural Analysis, P.N.Godbole, R.S. Sonparote, S.U.Dhote, PHI.
4. Theory of Plates and Shells, Timoshenko & Krieger, Mc-Graw-Hill
5. Theory of Elasticty, Timoshenko & Goodier, Mc-Graw-Hill

Subject Name: REMOTE SENSING AND GIS

Subject Code: CIVL 4142

Contacts: 3 L + 1 T

Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Understand the principles, applications, trends, and pertinent issues of geographical information systems and sciences, including remote sensing (RS), Photogrammetry, cartography, and global positioning systems (GPS).
2. Provide learning and teaching experiences with real world problems.
3. Develop technical skills and competence in data and information acquisition, extraction, management and analysis; spatial and statistical modelling; mapping and visualization.
4. Increase awareness of GIS and modelling tools for improving competition and business potential.
5. Describe how geographical information is used, managed, and marketed globally.

SL No.	Module	Details of Course Contents	Hours	Total
1	I	**Introduction:** Definition and types of remote sensing, Tacheometry (Planimetry/ altimetry), Triangulation (Frame work / adjustment), Trilateration (EDM/ Total Station), Geodetics (physical/geometrical geodesy), Error Analysis (causes / law of weights), Numerical example.	8	36
2	II	**Photogrammetry:** Camera System (phototheodolite/aircraft), Ground photograph (oblique/orthogonal streophoto), Aerial photograph (perspective scale/ flight planning), distortion (relief / tilt), Geometrix (parallax / mapping), application (topographics / interpretation), Numerical examples	10	
3	III	**Remote Sensing:** Satellite Sensing (Sensors / platforms), energy sources (electromagnetic /atmospheric interaction), visual interpretation (Band width), digital processing (imageries / enhancement), data integration (multi-approach / GIS), microwave imaging (active system / radars), applications, Information extraction from satellite images.	10	

Tapas Saha

4	IV	**Geoinformatics:** GIS concept (Introduction/ definition), planning and management, spatial data model, linking of attributes, geospatial analysis, modern trends.	8	

RECOMMENDED BOOKS:

Text and Reference Books			
SL. No.	**Name of the books**	**Publishers**	**Author**
1	Remote Sensing & GIS	Oxford University Press	Basudeb Bhatta
2	Remote Sensing & Image Interpretation	Wiley	Lilesand, Kiefer and Chipman
3	Remote Sensing & Geographical information System	BS publication	Reddy M.A.
4	Surveying (Volume 2)	NCBA Publisher, New Delhi	Kanetker & Kulkarni
5	Surveying	Pearson Education	Bannister, Raymond & Baker

Subject Name: ADVANCED PAVEMENT ENGINEERING

Subject Code: CIVL 4143

Contacts: 3 L + 1 T

Credit: 3

Course Outcome:

At the end of the course, the student will be able to:

1. Differentiate between different types of pavements, both structurally and functionally.
2. Conduct Axle Load Survey and Estimate Design Traffic.
3. Analyze and design bituminous and cement concrete pavement using.
4. Understand the principles of Pavement Maintenance and identify various pavement distresses.

SL. No	Module	Details of Course Contents	Hours	Total
1.	I	**Introduction:** Classification of pavements, Difference between highway and runway pavements, Factors affecting structural design. Concept of innovative pavement materials, Geometric design of Hill Roads.	6	38
2.	II	**Traffic Considerations in Pavement Design:** Vehicle types, Axle configurations, Contact shapes and contact stress distribution, Concept of standard axle load and ESWL, Vehicle damage factor, Axle load surveys, Estimation of design traffic	8	
3.	III	**Pavement Analysis and Design:** Principles of pavement design: Concepts of structural and functional failures, Performance criteria; Analysis of pavements: Analysis of stress, strain and deflection characteristics of flexible and rigid pavements, Linear Elastic Theory. Design of flexible and rigid pavements by IRC, AASHTO and other important methods.	12	
4.	IV	**Pavement Maintenance:** Distresses in Pavement; Functional Evaluation of Pavement (Pavement Roughness and Skid Resistance); Structural Evaluation Of pavement (Benkelman Beam and Falling Weight Deflectometer); Pavement Maintenance with and without Overlay.	12	

RECOMMENDED BOOKS:

TEXT & REFERENCE BOOKS	
Sl. No.	**Name of the books**
1	Principles of Pavement Design, E. J. Yoder & M.W. Witzack, John Wiley and Sons
2.	Pavement Analysis and Design, Yang H. Huang, Pearson
3.	Principles of Transportation Engineering, P. Chakraborty& A. Das - PHI
4.	D. Croney & P. Croney, Design and Performance of Road Pavements, McGraw-Hill Professional; 3 rd edition, 1997.
5.	Highway Engineering, Khanna& Justo, Nemchand& Brothers, Roorkee.
CODES FOR REFERENCE	
Sl. No.	**Name of the Codes**
6.	Relevant latest IRC Codes (IRC-37 – 2001, IRC-37 – 2012, IRC 58 – 2015, IRC 81 -1997- Indian Road Congress
7.	Relevant AASHTO Guidelines

Subject Name: HYDRAULICS STRUCTURES

Subject Code: CIVL 4144

Contacts: 3 L + 1 T

Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Integrate themselves in water-structures design applications.
2. Solve multi-variable hydraulic design problems in an open-ended solution space.
3. Develop understanding of the basic principles and concepts of analysis and design of hydraulic structures.

SL No.	Module	Details of Course Contents	Hours	Total
1	I	**Diversion Head Works:** Necessity, Difference between weir and Barrage, Type of Weirs, Selection of site, layout and description of each part, Effects of construction of a weir on the river regime.	8	38
2	II	**Theories of seepage and Design of weirs and Barrages:** Failure of Hydraulic Structures Founded on Pervious foundations: i) By piping ii) By Direct uplift, Bligh's creep theory of seepage flow, Khosla's theory & concept of flow nets, concept of exit gradient and critical exit gradient, Khosla's method of independent variable for determination of pressures and exit gradient for seepage below a weir or a barrage, necessary corrections, examples.	10	
3	III	**Dam (General):** Definition, classification of Dams, factors governing selection of type of dam, selection of suitable site for a dam. **Earthen Dams:** Introduction, Types of Earthen Dams, Methods of Construction, Causes offailure, Design Criteria, Determination of line of seepage or phreatic line in Earthen Dam, seepage control in Earthen Dam, Examples.	5 5	
4	IV	**Gravity Dam:** Definition, Typical cross-section, Forces acting on Gravity Dam, Combination of forces for design, Mode of failure and criteria for structural stability of Gravity Dams, Principal and shear stresses. Elementary profile of a Gravity Dam, Concept of High and low Gravity Dam, Examples.	10	

Recommended Books:

Text and Reference Books	
SL. No.	**Name of the books**
1	"Irrigation Engineering and hydraulic structures." by Santosh Kumar Garg (Khanna Publishers)
2	"Irrigation, water Resources and Water Power Engg." by Dr.P.N. Modi (Standard Book House, Delhi-6)
3	"Irrigation and Water Resources Engineering" by G.L. Asawa, (New Age International Publishers, New Delhi (2005).)

Subject Name: SOIL DYNAMICS AND MACHINE FOUNDATIONS

Subject Code: CIVL 4161

Contacts: 3 L + 1 T

Credit: 4

Course Outcome:

After going through this course, the students will be able to:

1. Understand the basic concept of vibration.
2. Define various aspects of machine foundation.
3. Illustrate and formulate equation for wave propagation.
4. Analyze and design block type machine foundation with an overview of rotary and impact type machines.
5. Enumerate dynamic properties of soil.
6. Examine liquefaction potential of soil and to mitigate hazards associated with it.

Sl. No.	Module	Details of Course Content	Hours	Total
1	I	**Fundamental of Vibrations**: Basic definitions, degrees of freedom, natural frequency, undamped single degree of freedom system, damped single degree freedom system, transmissibility, response to ground motion, introduction to multiple degree freedom system.	9	42
2	II	**Introduction to Machine Foundation**: Types of machine foundations, general requirement of machine foundations, dimensional criteria, design data, permissible amplitude, permissible bearing pressure. **Propagation of elastic waves in soils**: Mechanism of wave propagation, Body waves, Surface waves, Rayleigh waves.	12	
3	III	**Analysis and Design of Block type Machine Foundation**: Modes of vibrations, methods of dynamic analysis, design considerations for dynamically loaded foundations and constructional features, design procedures for foundations for hammers, reciprocating engines, vibration isolation and damping. **Introduction to Rotary and Impact type machines**	12	
4	IV	**Dynamic properties of Soil**: Introduction, laboratory and field evaluation of soil properties as per IS codes, **Liquefaction of Soil**: Definition, causes and effects of liquefaction, evaluation of liquefaction potential, mitigation of liquefaction hazards.	9	

RECOMMENDED BOOKS:

TEXT & REFERENCE BOOKS	
Sl. No.	**Name of the books**
1.	Hand Book of Machine Foundation, Srinivasalu and Vaidyanathan, Mcgraw Hill Education
2.	Geotechnical Earthquake Engineering, S. L. Kramer, Pearson India
3.	Earthquke Resistant Design, D. J. Dorwick, John Wiley & Sons Inc
4.	Fundamentals of Soil Dynamics & Earthquake Engineering, B. B. Prasad, Phi Learning Pvt. Ltd.
5.	Principles of Soil Dynamics, B. M. Das and Z. Luo, Cengage Learning.
6.	Soil Dynamics and Machine Foundations, Swami Saran, Galgotia Publications.

CODES FOR REFERENCE:

Sl. No.	**Name of the Codes**
7.	IS 2974, IS 5249

Subject Name: STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING

Subject Code: CIVL 4162

Contacts: 3 L + 1 T

Credit: 4

Course Outcome:

After going through the course:

1. Knowledge of students about Earthquake Engineering will advance enormously.
2. Student will understand the behavior of structures under earthquake.
3. Student will get an idea about the practical applications of earthquake engineering.
4. Student will be able to design the ductile detailing of structures.

Sl. No.	Module	Details of Course Content	Contact hours	Total
1.	I	**Theory of vibration:** Degrees of freedom, Undamped single degree freedom system, Damped single degree freedom system, Natural frequency, modes of vibration, Introduction to multiple degree freedom system	10	44
2.	II	**Response of single degree freedom system due to harmonic loading:** Undamped Harmonic excitation, Damped harmonic excitation. **Response due to Transient loading:** Duhamel's Integral, Response due to constant force, rectangular load, Introduction to numerical evaluation of Duhamel's integral of un-damped system.	10	
3.	III	**Elements of seismology**: Fundamentals: Elastic Rebound Theory, Plate tectonics, Definitions of magnitude, Intensity, Epicenter etc. Seismograph, Seismic zoning. Response of simple structural system, recent Earth Quakes.	10	
4.	IV	**Principles of Earthquake Resistant Design**: Terminology, General Principles and Philosophy of earth quake resistant design, Methods of analysis, Equivalent lateral force method and response spectrum method of analysis for multistoried building as per Indian Standard Code of Practice, Fundamental concepts of ductile detailing, Introduction to performance based design.	14	

Tapas Sadhu

References:

1. Structural Dynamics (Theory and computation), Mario Paz, CBS Publishers and Distributor.
2. Dynamics of Structures, Clough and Penzien, Computers & Structures, Inc. 1995 University Ave.Berkeley, CA 94704USA
3. Dynamics of Structure (Theory and application to earthquake engineering), A. K. Chopra, Pearson Education.
4. Dynamics of Structures, Ashok K. Jain, Pearson Education.
5. Earthquake resistant design of Structures, Agarwal and Shrikhande, PHI.
6. Earthquake-resistant design of structures, S.K. Duggal, Oxford University Press.
7. IS1893: PartI, 2002, IS 13920:1993, IS4326:1993.

Subject Name: ENVIRONMENTAL POLLUTION & CONTROL

Subject Code: CIVL 4163

Contacts: 3 L + 1 T

Credit: 4

Course Outcome:

1. Understanding the basic concepts of environmental pollution.
2. Ability to justify the use of pollution control equipment and their design.
3. Ability to identify air pollution problems.
4. Understand industry specific treatment technologies.
5. Capacity to assess the various aspects of noise pollution and understand the different environmental laws.
6. Get an overall understanding of various ways to manage solid waste.

Sl. No.	Module	Details of Course Content	Contact hours	Total
1	I	**Introduction**: Overview on Environmental Pollution- Air, Water, Solid waste. Concept of Pollution control- Air, Water, Solid waste. **Air Pollution**: Air Pollutants: Types- Primary and secondary pollutant, Sources, Effects; Air quality standard. Meteorological aspect of Air Pollution: Lapse Rate, Inversion, Plume Pattern; Air Pollution Dispersion Model: Point Source Gaussian Plume Model, Stability Classes, Stability Charts, Design of Stack Height.	2 8	10
2	II	**Air pollution Control**: Self cleansing mechanism of the environment; Dilution method; Engineered Control of Air Pollutants: Control of the particulates, Control of Gaseous Pollutants, Control of Air pollution from Automobiles. **Industrial Water pollution control**: Characteristics of various industrial waste water- physical and chemical. Specific treatment technologies- physical, chemical and biological, Management of treatment plant sludge.	8 2	10

Tapas Saha

3	III	**Noise Pollution:** Definition; Sources of noise, characteristics of noise; Sound Pressure, Power and Intensity level; Noise Measurement: Relationships among Pressure, Power and Intensity Levels, Frequency Band, Decibel Addition, Measures of community Noise i.e. L_N, L_{eq}, L_{dn}, L_{NP}; strategies for noise pollution control. **Global Environmental Issues**: Ozone Depletion, Acid Rain, Global Warming-Green House Effects, Eutrophication, photochemical smog.	4 4	8
4	IV	**Administrative Control on Environment:** Functions of Central and State Pollution Control Boards; Environmental Clearance Process for Industries and Infrastructural Projects. **Environmental Laws:** Relevant Water Acts, Air Acts, Motor Vehicle Acts, solid and hazardous waste acts. **Solid Waste Management:** Introduction, Source, Quality and composition of municipal solid waste, Collection, transfer, processing and transportation, Method of disposal- Sanitary landfill, Composting, Incineration, Pyrolysis, Anaerobic digestion and Energy recovery.	2 2 4	8

Recommended books:

Sl. No.	Title	Author	Publisher
1	Introduction to Environmental Engineering and Science	G. Masters, W. Ela	PHI
2	Environmental Engineering: A Design Approach	A. Sincero, G. Sincero	PHI
3	Environmental Engineering	H. Peavy, D. Rowe, G. Tchobanoglous	TMH
4	Environmental Engineering, Vol. II	S.K . Garg	Khanna Publishers
5	Air Polution	Rao and Rao	TMH
6	Water Supply, Waste Disposal and Environmental Pollution Engineering	A.K.Chatterjee	Khanna Publishers
7	Sewage Treatment & Disposal And Wastewater Engg	P. N. Modi	Standard Book House
8	Integrated solid waste management: engineering principles and management issues	G.Tchobanoglous, H.Theisen, S. A. Vigil	McGraw-Hill

Tapas Saha

Subject Name: ADVANCED R.C.C. DESIGN

Subject Code: CIVL 4164

Contacts: 3 L + 1 T

Credit: 4

Course Outcome:

1. To perform the analysis and design of reinforced concrete members and their connections.
2. To identify and apply the industrial design codes relevant to the design of Reinforced concrete members.
3. To be familiar with the professional and contemporary design issues and fabrication of Reinforced concrete members.

Sl. No.	Module	Details of Course Content	Contact hours	Total
1	I	**Overall Review:** Review of Limit State Design of Beams, Slabs & Columns according to IS 456-2000. Yield line theory, Biaxial Bending & Slander Column. **Analysis and Design of beams curved in plan:** Design principle, structural design of beams curved in plan of circular and rectangular types. **Flat slabs:** Introduction, components – IS code provisions- Design method –Design for flexure and shear and Detailing.	3 5 3	40
2	II	**Deep beams:** Introduction, Flexural and shear stresses in deep beam and Design and Detailing. **Water tank:** Introduction, Types, Analysis and Design of water tanks e.g. Underground & Elevated water tank (Circular, Rectangle and Intz)	3 6	
3	III	**Raft Foundation:** Introduction, Types and Design of raft foundation. **Design** of folded plate **Design** of shear wall as per IS 13920	4 4 2	
4	IV	**Design of bunkers and silos**: Introduction, Difference between Bunkers and Silo (rectangular, square and circular bunker and silo design for storage of cement). **Analysis and design of chimneys:** Introduction and different type of linings, wind load calculation on chimney (Static and dynamic) Analysis and design of chimney linings, foundation types.	4 6	

Recommended books:-

Code: IS 3370 -2009 (Part-II, IV)
IS-456-2000
SP-16
IS 1893-2016
IS-875-2015 (PART-III)

TEXT BOOKS:

1. Advanced RCC Design by S.S.Bhavikatti, New Age International
2. Advanced RCC Design by N. Krishnaraju, CBS publishers
3. Advanced Reinforced Concrete Design by P.C. Varghese, PHI publishers
4. Chimney Design & construction by S.N.Manohar, Tata McGraw Hill.

Subject Name: BUILDING MATERIALS

Subject Code: CIVL 4181

Contacts: 3 L

Credit: 3

Course Outcome:

At the end of the course, the student will be able to:

1. Learn and use common terms used in building industry.
2. Able to understand and utilize basic principles used in building industry.
3. Will be aware of the application of these materials.
4. Can display safe and professional work practice.

Sl. No.	Module	Details of Course Content	Contact hours	Total
1	I	**Building Materials - I** Bricks: Introduction, Classification, Characteristics of good bricks, Ingredients of good brick earth, Harmful substance in brick earth, Different forms of bricks, Testing of bricks, Defects of bricks, Fly ash brick. Cement: Introduction, Chemical Composition of Cement, Hydration of Cement. Tests on Cement and Cement Paste – specific gravity, fineness, consistency, setting time, soundness, strength. Manufacturing of cement. Types of Portland Cement – Ordinary, Rapid hardening, Low-heat, Sulphate resisting, Portland slag, Portland pozzolana, Super sulphated cement, White cement. Aggregates: Introduction, Classification, Mechanical and Physical Properties, Deleterious Substances, Alkali-Aggregate Reaction. Testing of Aggregates – Particle size distribution, Flakiness, Elongation Tests, Aggregate Crushing Value, Ten Percent Fines Value, Impact Value, Abrasion Value	2 5 5	35
2	II	**Building Materials -II** Ferrous Metals: Introduction, Pig Iron- composition, properties, uses. Cast Iron-Properties, Manufacturing, uses. Wrought iron-properties, uses. Steel- composition, properties, manufacturing, uses. Rolled steel sections, Wide flanged section, Reinforcing steel bars (TMT bars). Corrosion of steel, Tensile testing of steel, Alloy steel. Mortars: Introduction, Classification, Uses, Characteristics of good mortar, Ingredients. Paints, Enamels and Varnishes: Composition of oil paint, characteristic of an ideal paint, preparation of paint, covering power of paints, Painting:	5 1 1	

		Plastered surfaces, painting wood surfaces, painting metal Surfaces. Defects, Effect of weather, enamels, distemper, water wash and colour wash, Varnish, French Polish, Wax Polish. Miscellaneous Materials		
3	III	**Building Construction -I** Foundations: Function of Foundations, Essential requirement of good foundation, Different types of shallow and deep Foundations. Brick masonry: Definitions, Rules for bonding, Type of bonds – stretcher bond, Header bond, English bond, Flemish Bond, Comparison of English Bond and Flemish Bond (one and one and half brick thick wall) Wall, Doors and Windows Load bearing wall, Partition wall, Reinforced brick wall Common types of doors and windows of timber and metal.	4 4 2	
4	IV	**Building Construction -II** Stairs: Technical Terms, Requirements of good stair, Dimension of steps, Classification, Geometric design of a dog legged stair case. Flooring: Components of a floor, selection of flooring materials, Brick flooring, Cement concrete flooring, mosaic, marble, Terrazzo flooring, Tiled roofing. Roofs: Types, Pitched roofs and their sketches, Lean – to roof, King Post – Truss, Queen post truss and Simple steel Truss, Roof Covering materials: AC sheets GI sheet.	2 2 2	

RECOMMENDED BOOKS:

TEXT BOOKS

Sl. No.	Name of the books
1.	*Building Materials* , Duggal S.K., New Age International
2.	*Building Materials*, Varghese P.C., PHI Learning Pvt. Ltd-New Delhi.
3.	*Building Construction*, Punmia B.C., Laxmi Publications.

REFERENCE BOOKS

Sl. No.	Name of the books
1.	*Concrete Technology*, M. S. Shetty R., S. Chand.
2.	*Concrete Technology*, Nevile A.M. & Brooks J.J., Pearson Education.
3.	*Engineering Materials*, S.C. Rangwala, Charotar Publishing

Subject Name: HYDROLOGY

Subject Code: CIVL 4182

Contacts: 3 L

Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Understand the design of water resources systems utilizing the basic principles of the hydrologic cycle and the watershed.
2. Review the fundamentals of fluid mechanics including fluid statics and dynamics.
3. Master the computation of flow in closed conduits including pipelines, pumps, and water supply systems.
4. Perform open channel flow design including water surface profiles, floodplain delineation, storm water and sanitary sewer design.
5. Understand the value of probability and statistical analysis in deriving precipitation and stream flow data.

Sl. No.	Module	Details of Course Content	Contact hours	Total
1.	I	Catchment area and Hydrologic cycle, Measurement of rainfall – Rain gauges, Estimation of missing rainfall data, checking of consistency, Optimum number of Rain gauges. Calculation of average rainfall over area – different methods, Frequency analysis of rainfall intensity duration curve. Rainfall mass curve, hyetograph, Examples.	4	36
		Evaporation, evapo-transpiration and infiltration: Processes, Factors affecting run off, estimation of run-off, rainfall run off relationship.	4	
2.	II	Stream flow measurement: Direct and indirect methods, Examples. Stage discharge relationships, back water effect, unsteady flow effect.	4	
		Hydrographs; characteristics: Base flow separation. Unit Hydrographs. Derivation of unit hydrographs, S-curve.	4	
		Types of Irrigation systems, methods of irrigation: Water requirements of crops: Crop period or Base period, Duty & Delta of a crop, relation between Duty & Delta, Duty at various places, flow Duty & quantity Duty, factors affecting Duty, measures for improving Duty of water, crop seasons.	4	

Tapas Saha

3.	III	Canal Irrigation: Introduction, classification of irrigation canals, Efficient section, certain important definitions, Time factor, Capacity factor, full supply coefficient, Nominal duty, Channel losses, Examples.	10	
4.	IV	Water logging and drainage: Causes, effects and prevention of water logging. Type of drains-open drains and closed drains (introduction only), Discharge and spacing of closed drains. Examples.	6	

RECOMMENDED BOOKS:

SL. No.	Name of Text and Reference books	Author	Publishers
1	Engineering Hydrology	K. Subramanya	Tata McGraw-Hill
2	A Text Book of Hydrology	P. Jaya Ram Reddy	Laxmi Publications-New Delhi
3	Irrigation, Water Resource & Water Power Engineering	Dr. P.N Modi	Standard Book House-New Delhi
4	Irrigation and Water Resources Engineering	G.L. Asawa,	New Age International Publishers, New Delhi (2005)

Subject Name: ENVIRONMENTAL POLLUTION & CONTROL

Subject Code: CIVL 4183

Contacts: 3 L

Credit: 3

Course Outcome:

To give an idea to the students about the different kinds of environmental pollution, viz. Air, Water, Noise, Solid Waste, their sources, characteristics, effects and control mechanisms as well as legislation issues.

Sl. No.	Module	Details of Course Content	Contact hours	Total
1	I	**Introduction**: Overview on Environmental Pollution- Air, Water, Solid waste. Concept of Pollution control- Air, Water, Solid waste. **Air Pollution**: Air Pollutants: Types- Primary and secondary pollutant, Sources, Effects; Air quality standard. Meteorological aspect of Air Pollution: Lapse Rate, Inversion, Plume Pattern; Air Pollution Dispersion Model: Point Source Gaussian Plume Model, Stability Classes, Stability Charts, Design of Stack Height.	2 8	10
2	II	**Air pollution Control**: Self cleansing mechanism of the environment; Dilution method; Engineered Control of Air Pollutants: Control of the particulates, Control of Gaseous Pollutants, Control of Air pollution from Automobiles. **Industrial Water pollution control**: Characteristics of various industrial waste water, physical and chemical. Specific treatment technologies- physical, chemical and biological, Management of treatment plant sludge.	8 2	10
3	III	**Noise Pollution:** Definition; Sources of noise, characteristics of noise; Sound Pressure, Power and Intensity level; Noise Measurement: Relationships among Pressure, Power and Intensity Levels, Frequency Band, Decibel Addition, Measures of community Noise i.e. L_N, L_{eq}, L_{dn}, L_{NP}; strategies for noise pollution control. **Global Environmental Issues**: Ozone Depletion, Acid Rain, Global Warming-Green House Effects, Eutrophication, photochemical smog.	4 4	8

Tapas Saha

4	**IV**	**Administrative Control on Environment:** Functions of Central and State Pollution Control Boards; Environmental Clearance Process for Industries and Infrastructural Projects. **Environmental Laws:** Relevant Water Acts, Air Acts, Motor Vehicle Acts, solid and hazardous waste acts. **Solid Waste Management:** Introduction, Source, Quality and composition of municipal solid waste, Collection, transfer, processing and transportation, Method of disposal- Sanitary landfill, Composting, Incineration, Pyrolysis, Anaerobic digestion and Energy recovery.	2 2 4	8

Recommended books:

Sl. No.	Title	Author	Publisher
1	Introduction to Environmental Engineering and Science	G. Masters, W. Ela	PHI
2	Environmental Engineering: A Design Approach	A. Sincero, G. Sincero	PHI
3	Environmental Engineering	H. Peavy, D. Rowe, G. Tchobanoglous	TMH
4	Environmental Engineering, Vol. II	S. K. Garg	Khanna Publishers
5	Air Polution	Rao and Rao	TMH
6	Water Supply, Waste Disposal and Environmental Pollution Engineering	A. K. Chatterjee	Khanna Publishers
7	Sewage Treatment & Disposal And Wastewater Engg	P. N. Modi	Standard Book House
8	Integrated solid waste management: engineering principles and management issues	G.Tchobanoglous, H.Theisen, S. A. Vigil	McGraw-Hill

Subject Name: COMPUTER APPLICATION IN CIVIL ENGINEERING
Subject Code: CIVL 4111
Contacts: 3 P
Credit: 2

Course Outcome:

After going through this course, the students will be able to:

1. Understand the details of STAAD.Pro software package.
2. To prepare input data of STAAD.Pro.
3. Run STAAD.Pro for analysis and designing of structures.
4. Design different components of structures.
5. Apply wind load and seismic loads from load definition
6. Assign built up section member properties and generate geometry using structural wizard.

Course Content:

1. Study of capabilities of STAAD software for modeling and design – Radial and Cartesian coordinate systems, generating simple structures like two dimensional and three dimensional frames and truss.
2. Study on space, plane, floor and truss options in STAAD.
3. Assigning steel and concrete materials to different structures. Application of built – up steel sections and steel – concrete composites.
4. Different supports available in STAAD.
5. Different loads like member load, floor load, area load, plate load, wind load, seismic load etc.
6. Design of a concrete framed structure using STAAD.
7. Design of an industrial shed using STAAD.

Tapas Sadhu

Subject Name: CONSTRUCTION PLANNING AND PROJECT MANAGEMENT
Subject Code: CIVL 4201
Contacts: 3 L
Credit: 3

Course Outcome:

At the end of the course, the student will be able to:

1. Develop the bar chart for the project.
2. Compile the tender documents.
3. Estimate the critical path of the project i.e. the maximum duration which the project require for completion.
4. Understand the uses of various construction equipments at site and the preparation of concrete.
5. Make use of the bylaws of different authorities to get the approval of drawings for construction.
6. Understand the process of arbitration in case the projects suffer from disputation.

SL. No.	Module	Details of Course Contents	Contact Hours	Total
1	I	**Planning**: General consideration, Definition of aspect, prospect, roominess, grouping, circulation, Privacy. **Regulation and Bye laws** : Bye Laws in respect of side space, Back and front space, Covered areas, height of building etc., Lavatory blocks , ventilation, Requirements for stairs, lifts in public assembly building, offices **Fire Protection**: Fire fighting arrangements in public assembly buildings, planning , offices, auditorium	2 4 2	36
2	II	**Construction plants & Equipment**: Plants & equipment for earth moving, road constructions, excavators, dozers, scrapers, spreaders, rollers, their uses. **Plants &Equipment for concrete construction**: Batching plants, Ready Mix Concrete, concrete mixers, Vibrators etc., quality control.	4 4	
3	III	**Planning &Scheduling of constructions Projects**: **Planning by CPM**: Preparation of network, Determination of slacks or floats. Critical activities. Critical path. Project duration. **Planning by PERT**: Expected mean time, probability of completion of project, Estimation of critical path, problems.	4 4	
4	IV	**Management: Professional practice**, Definition, Rights and responsibilities of owner, engineer, Contractors, types of contract **Departmental Procedures**: Administration, Technical and financial sanction, operation of PWD, Tenders and its notification, EMD and SD, Acceptance of tenders, Arbitration	4 8	

Tapas Sadhu

Recommended books, IS Codes:-

1. Estimating, costing, Specification and Valuation in Civil Engineering by M. Chakroborty
2. Construction Planning, Equipments and methods Puerifoy, R.L. McGraw Hill.
3. Management in construction industry P. P. Dharwadkar Oxford and IBH Publishing company New Delhi
4. Construction Management, Critical path Methods in Construction, J. O. Brien Wiley Interscience
5. PERT and CPM L. S. Srinath
6. Project planning and control with PERT and CPM' Construction equipments and its management B. C. Punmia, K. K. Kandelwal and S. C. Sharma
7. National Building code BIS

Subject Name: BRIDGE ENGINEERING

Subject Code: CIVL 4241

Contacts: 3L + 1T

Credit: 4

Course Outcome:

After going through this course, the students will be able to:

1) Discuss basic definitions, types, and components of bridges.
2) Discuss sub-surface investigations required for bridge construction.
3) Understand standard specification and loads for bride design.
4) Perform design of different types bearings and joints for bridges.
5) Perform design of various reinforced concrete and steel bridges.

Sl. No.	Module	Details of Course Content	Contact hours	Total
1	I	**Introduction**: Definition and basic forms, components of a typical bridge, classification of bridges, site investigation, bridge hydrology and hydraulics. **Loads**: I.R.C loads, impact factors, wind loads, longitudinal forces, lateral forces and centrifugal forces. **Bearings**: Types of bearings, details of bearing, joints, design examples.	4	44
2	II	**Reinforced concrete solid slab bridge**: Introduction, general design features, economic span, effective width method, simply supported and cantilever slab bridges, analysis and design. **Box culvert bridge**: Introduction, design method and design example.	14	
3	III	**Design of a T beam bridge**: Introduction, components, design of interior panel of slab, longitudinal and cross girders, Pigeaud's method, design example. **Composite bridge**: General aspects, method of construction, analysis of composite section, shear connectors, design of composite beam.	14	
4	IV	**Steel bridges**: General features, types of stress, design of railway truss bridge and plate girder bridge. **Cable Stayed Bridge**: General features, Philosophy of design.	12	

Text and References:

Sl. No	Name	Author	Publishers
1.	Design and Construction and Highway Bridges	K. S. Rakshit	New Central Book Agency (P) Limited
2.	Bridge Engineering	S. Ponnusamy	McGraw Hill India, New Delhi.
3.	Design of Concrete Bridges	Aswani, Vizirani Ratwani	Khanna Publishers
4.	Design of Steel Structures	Arya and Ajmani	Nem Chand and Bros.

Subject Name: TRAFFIC ENGINEERING AND TRANSPORTATION PLANNING

Subject Code: CIVL 4242

Contacts: 3L + 1T

Credit: 4

Course Outcome:

At the end of the course, the student will be able to:

1) Understand various road user and vehicular characteristics, Analysing traffic flow parameters at Mid-block section and Intersections.
2) Conduct traffic studies and get an idea about traffic regulations & management measures, Parking, Road safety.
3) Plan and evaluate economical transportation systems and Prepare project reports.
4) Understand the principles of Urban transport planning.

SL. No	Module	Details of Course Contents	Contact Hours	Total
1	I	**Traffic Engineering:** Organization of traffic engineering department and its importance under Indian conditions, Road User Characteristics, Human factors governing road user behaviour, vehicle characteristics, slow moving traffic characteristics in Indian conditions. **Traffic flow parameters:** Speed, density and volume relationships, Headway, Spacing, Delay **Intersection:** Road Intersection, Basic Traffic Conflicts, Classification of at-grade intersection, Channelisation , Rotary.	3 4 3	33
2	II	**Traffic Engineering Studies and Surveys:** Traffic Volume Study, Speed Studies, Origin and Destination Study, Traffic Capacity Studies, Parking Studies, Accident Studies. Traffic regulations, Traffic management measures, Traffic signals, Traffic Signs and Markings. **Parking and Accidents:** Parking types, ill effects of parking, off street parking facilities, Causes of Accidents, Accident Studies and Records, Accident Investigations, Measures for the Reduction in Accident Rates.	2 2 3	
3	III	**Transportation Planning**: Brief ideas about urban and regional transportation systems; Components of Transportation system planning; Land use planning, Systems approach to transport planning, Stages in transport planning. Economic evaluation of transportation plans, Preparation of Project Report.	4 4	

Tapas Sadhu

4	IV	**Urban Transport Planning:** Elements of Urban Transport Planning, Planning and Work Programme, Transportation Plan, Plan Refinement, Urban Activity Forecast, Overview of Information Needs. Trip generation and distribution, Traffic assignment and modal split, Transport Demand Analysis.	4 4	

RECOMMENDED BOOKS:

TEXT BOOKS	
Sl. No.	**Name of the books**
1.	Traffic Engineering and Transport Planning, L.R. Kadiyali, Khanna Publishers, New Delhi
2.	Transportation Engg: An introduction, C. J. Khisty& B. K. Lall,
3.	Transportation Planning, C. S. Papacostas and P. D. Prevedouros

Subject Name: ADVANCED FOUNDATION ENGINEERING

Subject Code: CIVL 4243

Contacts: 3L + 1T

Credit: 4

Course Outcome:

After going through this course, the students will be able to:

1. Design of shallow and deep foundations to carry ultimate loads.
2. Understand advantages and limitations of advanced analytical techniques.
3. Assess dewatering mechanism also design of braced excavation.

SL. No.	Module	Details of Course Contents	Hours	Total
1.	I	**Shallow foundations**: Types of shallow foundation. **Advanced Method of Analysis**: Beams on elastic foundation – Infinite beam, finite beam, Modulus of subgrade reaction, factors affecting modulus of subgrade reaction. **Raft foundation**: Settlement and bearing capacity analysis, analysis of flexible and rigid raft as per IS code.	9	39
2.	II	**Pile foundation**: Vertical, uplift and lateral capacity, elastic continuum approach, ultimate load analysis, Brom's method, settlement of pile and pile group, pile load test and cyclic load test, analysis and geotechnical design of piled raft. **Drilled shaft** – construction procedure, design considerations, load carrying capacity and settlement analysis. **Foundation on expansive soils and collapsible soils**: Problems and remedies.	11	
3.	III	**Well foundation and its elements**: Size and depth; forces on well foundation; methods of sinking; scour depth; analysis of well foundation for bearing capacity and lateral stability. **Caison type** – sinking and control.	10	
4.	IV	**Braced excavation**: Types of bracing system; stability considerations; heave and uplift computation of earth pressure and strut load; ground movement, construction control. **Dewatering**: Field pumping test; common dewatering methods; effects of dewatering.	9	

RECOMMENDED BOOKS:

TEXT & REFERENCE BOOKS	
Sl. No.	Name of the books
1.	Foundation Analysis and Design, J. E. Bowels, McGraw Hill
2.	Principles of Foundation Engineering, B. M. Das, Thomson Book
3.	Advanced Foundation Engineering, N. Som and S.C. Das, PHI Learning Pvt. Ltd.
4.	Advanced Foundation Engineering, V. N. S. Murthy, CBS Publishers
5.	Foundation Engineering, P. C. Varghese, PHI Learning Pvt. Ltd.

CODES FOR REFERENCE:

Sl. No.	Name of the Codes
6.	IS 1904, 6403, 8009, 2950, 2911

Subject Name: FINITE ELEMENT ANALYSIS

Subject Code: CIVL 4244

Contacts: 3L + 1T

Credit: 4

Course Outcome:

After going through this course, the students will be able to:

1. Obtain an understanding of the fundamental theory of the FEA method.
2. Develop the ability to generate the governing FE equations for systems governed by partial differential equations.
3. Understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements and

SL. No.	Module	Details of Course Content	Contact Hours	Total
1	I	**Introduction to Finite Element Analysis:** Basic Concepts of Finite Element Analysis and its necessity. **Numerical tools for Finite Element Formulation:** Variational Principle: Ritz method, Weighted residual method: Galerkin approach, Petrov-Galerkin approach.	2 8	44
2	II	**Finite element Formulation:** Formulation of Euler-Bernoulli beam element and Timoshenko beam element, Imposition of boundary conditions.	12	
3	III	**Elements and their properties:** One dimensional and Two dimensional elements (Bar element, Beam element, Plate element), Interpolation functions, Numerical integration.	10	
4	IV	**Finite element solutions:** Formulation of stiffness matrix and solution of beam, plate and truss problems, Problems on Plates with cutout. Introduction to the software SAP2000.	12	

Recommended books:-

TEXT BOOKS	
Sl. No.	**Name of the books**
1.	Bathe K.J, *Finite Element Procedures.* Prentice Hall India Learning Private Limited (1996).
2.	Cook R.D, Malkus, Plesha and Witt, *Concepts and Applications of Finite Elements Analysis,* 4th edition, Wiley.
3.	Mukhopadhyay M. and Hamid S. A., *Matrix and Finite Element Analyses of Structures,* ANE Books.
4.	Reddy J.N., An Introduction to the Finite Element Method, 3rd edition, , McGraw Hill Publication

Tapas Sadhu

REFERENCE BOOKS	
Sl. No.	Name of the books
5.	Krishnamoorty C. S., *Finite Element Analysis: Theory and Programming*, 2ndedition, McGraw Hill Publication.
6.	ChandrupatlaT. R. and Belegundu A. D., *Introduction to Finite Elements in Engineering*, 4th edition, Prentice Hall India Learning Private Limited.

Subject Name: REMOTE SENSING AND GIS

Subject Code: CIVL 4281

Contacts: 3L

Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Understand the principles, applications, trends, and pertinent issues of geographical information systems and sciences, including remote sensing (RS), Photogrammetry, cartography, and global positioning systems (GPS).
2. Provide learning and teaching experiences with real world problems.
3. Develop technical skills and competence in data and information acquisition, extraction, management and analysis; spatial and statistical modelling; mapping and visualization.
4. Increase awareness of GIS and modelling tools for improving competition and business potential.
5. Describe how geographical information is used, managed, and marketed globally.

SL. No.	Module	Details of Course Contents	Contact Hours	Total
1	I	**Introduction:** Definition and types of remote sensing, Tacheometry (Planimetry/ altimetry), Triangulation (Frame work / adjustment), Trilateration (EDM/ Total Station), Geodetics (physical/geometrical geodesy), Error Analysis (causes / law of weights), Numerical example.	8	36
2	II	**Photogrammetry:** Camera System (phototheodolite/aircraft), Ground photograph (oblique/orthogonal streophoto), Aerial photograph (perspective scale/ flight planning), distortion (relief / tilt), Geometrix (parallax / mapping), application (topographics / interpretation), Numerical examples	10	
3	III	**Remote Sensing:** Satellite Sensing (Sensors / platforms), energy sources (electromagnetic /atmospheric interaction), visual interpretation (Band width), digital processing (imageries / enhancement), data integration (multi-approach / GIS), microwave imaging (active system / radars), applications, Information extraction from satellite images.	10	
4	IV	**Geoinformatics:** GIS concept (Introduction/ definition), planning and management, spatial data model, linking of attributes, geospatial analysis, modern trends.	8	

Tapas Saha

RECOMMENDED BOOKS:

Text and Reference Books			
SL. No.	**Name of the books**	**Publishers**	**Author**
1	Remote Sensing & GIS	Oxford University Press	Basudeb Bhatta
2	Remote Sensing & Image Interpretation	Wiley	Lilesand, Kiefer and Chipman
3	Remote Sensing & Geographical information System	BS publication	Reddy M.A.
4	Surveying (Volume 2)	NCBA Publisher, New Delhi	Kanetker & Kulkarni
5	Surveying	Pearson Education	Bannister, Raymond & Baker

Subject Name: PRINCIPLES OF SURVEYING

Subject Code: CIVL 4282

Contacts: 3L

Credit: 3

Course Outcome:

After going through this course, the students will be able to:

1. Carry out preliminary surveying in the field,
2. Take accurate measurements, field booking, plotting and adjustment of traverse,
3. Use various conventional instruments involved in surveying.

SL. No.	Module	Details of Course Content	Contact Hours	Total
1.	I	INTRODUCTIONTO SURVEYING Definition, principles of surveying, types of scales (numerical problems), basic concepts of plans and maps. CHAIN SURVEYING Types of chains,accessories for chain surveying with their use, methods of ranging and methods of offsets, obstacles in chain surveying.	5 5 (10)	40
2.	II	COMPASS SURVEYING Definition, instrument and terminology, local attraction and its elimination, Open and closed traverse, adjustment of traverse. PLANE TABLE SURVEYING Principle, equipment and methods, two and three point problems.	5 5 (10)	
3.	III	LEVELLING Definitions and terminology, types and methods of leveling, use of leveling instruments and supporting accessories. CONTOURING Different terms used in contouring, characteristicsof contour and contour interval, preparation of contour maps.	5 5 (10)	
4.	IV	THEODOLITE SURVEYING Components of Theodolite, adjustments, measurement of vertical and horizontal angels, concepts of trigonometric leveling, TACHEOMETRY Definitions and principles of tachometry and stadia system, fixed hair stadia method, calculation of horizontal and vertical distance using tachometer.	5 5 (10)	

Tapas Saha

Recommended books:-

TEXT BOOKS	
Sl. No.	**Name of the books**
1.	Basak N.N. *Surveying and Levelling.* 2nd edition, McGraw Hill Education.
2.	Roy S.K. *Fundamentals of Surveying*. 2nd edition, PHI Learning Pvt. Ltd-New Delhi.

REFERENCE BOOKS	
Sl. No.	**Name of the books**
3.	Venkatramaiah C. *Textbook of Surveying*. 2nd edition, Orient Blackswan Pvt. Ltd. –New Delhi.
4.	Duggal S. K. *Surveying (Vol-1 and 2)*. 4th edition, McGraw Hill Education (India) Pvt Ltd.

Subject Name: PROJECT PLANNING AND MANAGEMENT

Subject Code: CIVL 4283

Contacts: 3L

Credit: 3

Course Outcome:

At the end of the course, the student will be able to:

1. Prepare the bar chart for the project.
2. Prepare the tender documents.
3. Estimate the critical path of the project i.e. the maximum duration which the project require for completion..
4. Familiar with the uses of various construction equipments at site
5. Familiar with by laws of different authorities to get the approval of drawings for construction.
6. Know the process of arbitration incase the projects suffer from disputation.

SL. No.	Module	Details of Course Contents	Hours	Total
1	I	**Planning**: General consideration, Definition of aspect, prospect, roominess, grouping, circulation, Privacy. **Regulation and Bye laws** : Bye Laws in respect of side space, Back and front space, Covered areas, height of building etc., Lavatory blocks , ventilation, Requirements for stairs, lifts in public assembly building, offices **Fire Protection**: Fire fighting arrangements in public assembly buildings, planning , offices, auditorium	2 4 2	36
2	II	**Construction plants & Equipment**: Plants & equipment for earth moving, road constructions, excavators, dozers, scrapers, spreaders, rollers, their uses. **Plants &Equipment for concrete construction**: Batching plants, Ready Mix Concrete, concrete mixers, Vibrators etc., quality control.	4 4	
3	III	**Planning &Scheduling of constructions Projects**: **Planning by CPM**: Preparation of network, Determination of slacks or floats. Critical activities. Critical path. Project duration. **Planning by PERT**: Expected mean time, probability of completion of project, Estimation of critical path, problems.	4 4	
4	IV	**Management: Professional practice**, Definition, Rights and responsibilities of owner, engineer, Contractors, types of contract **Departmental Procedures**: Administration, Technical and financial sanction, operation of PWD, Tenders and its notification, EMD and SD, Acceptance of tenders, Arbitration.	4 8	

Tapas Sadhu

Recommended books, IS Codes:-

1. Estimating, costing, Specification and Valuation in Civil Engineering by M. Chakroborty
2. Construction Planning, Equipments and methods Puerifoy, R.L. McGraw Hill.
3. Management in construction industry P.P.Dharwadkar Oxford and IBH Publishingcompany New Delhi
4. Construction Management, Critical path Methods in Construction, J.O.Brien Wiley Interscience
5. PERT and CPM L.S. Srinath
6. Project planning and control with PERT and CPM' Construction equipments and its management B.C.Punmia, K.K.Kandelwal and S.C.Sharma
7. National Building code BIS

Subject Name: Animal Cell Culture and Animal Biotechnology					
Paper Code: BIOT4101					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completion of this course, student will be able to

1. Understand the fundamental scientific principles animal cell culture, describe the condition, media, special instruments and laboratory design required for animal cell culture.
2. Acquire knowledge for isolation, maintenance, counting, preservation and growth of animal cell, develop proficiency in establishing and maintaining of cell lines.
3. Acquire knowledge in animal cloning and its applications.
4. Understand and analyse growth kinetics and scale up of animal cell culture.Do analysis and solve problems related to animal cell culture.
5. Understand and explain the basics of animal biotechnology and the creation of transgenic animal with the help of modern gene targeting and editing technology.
6. Describe and demonstrate the application of animal cell culture and animal biotechnology in production of monoclonal antibody, organ transplantation, production of human and animal viral vaccines and pharmaceutical proteins, gene therapy, stem cell technology.

Module I: Animal cell culture [10L]

Introduction Animal Tissue Culture, Cell adhesion, proliferation, differentiation, senescence and apoptosis. Basci requirement of animal cell and tissue culture laboratory, biosafety levels, culture media and growth conditions. Development of primary culture, subculture and cell lines. Cell cloning and selection, Cell Differentiation into cancerous cells and role of protooncogenes, cell synchronization, senescence and apoptosis. cryopreservation; Common cell culture contaminants. Techniques for animal cell separation, characterization, quantitation, cytotoxicity and viability assays.

Module III: Growth and scale up of animal cell culture [10L]

Introduction to non-ideal reactor. Animal cell growth characteristics and kinetics, cell culture reactors, scale-up in suspension, scale and complexity, mixing and aeration, rotating chambers, perfused suspension cultures, fluidized bed reactors for suspension culture. Scale-up in monolayers, multisurface propagators, multiarray disks, spirals and tubes, roller culture, micro-carrier attached growth. Cell culture in continuous, perfusion and hollow fibre reactor, microencapsulation. Growth monitoring and mass transfer in mammalian cell culture.

Module III: Animal biotechnology [10L]

Micromanipulation of embryos: Introduction, basics and methodology of micromanipulations. Composition of *in vitro* fertilization (IVF) media, steps involved in IVF.

Transfection and transformation of animal cells. Transgenic animal production: concept of transgene and transgenic animals, gene transfer approaches for producing transgenic animals, techniques of creating transgenic mice, homologous recombination and knockout mice. Animal cloning using stem cells and other methods. Importance and applications of transgenic animals, study of model transgenic animals.

Module IV: Application of animal cell culture and animal biotechnology [10L]

Three dimensional culture technology: organ culture, histolytic culture, Organotypic culture, tissue engineering and its application. Cell fusion and hybridoma technology, regenerative medicine, tissue and organ transplantation, production of human and animal viral vaccines and pharmaceutical proteins, gene therapy, Stem cell technology, Marketable culture product, different medical applications for cell culture including expression system, therapeutics and others.

Textbook:

1. Culture of Animal Cells: A Manual of Basic Technique and Specialized application, 7^{th} Edn.(2016) by R. Ian Freshney , pub- Wiley-Blackwell.
2. Basic Cell Culture 2^{nd} Edn. (2005),by Davis. J.M, pub- Oxford University Press.
3. Animal Cell Culture: A Practical Approach (2000) by John Masters, pub- Oxford University Press.
4. Primrose & Twyman, Principles of Gene Manipulation and Genomics, 7th Edn, (2006)
5. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) by Glick, Pasternak, and Patten, pub- ASM Press,

Reference books :

1. Concepts in Biotechnology (1996) by Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman.
2. Text Book of Biotechnology, 4^{th} Edn. (2007) Das. H.K., pub-Wiley Dreamtech.
3. Transgenic Animals: Generation and Use 5th Edition (1997) Louis-Marie Houdebine, pub- CRC Press.
4. Embryonic Stem cells by Kursad and Turksen. 2002. Humana Press.
5. Animal Biotechnology by P.Ramadas
6. In vitro cultivation of Animal cells by Dr.C.K.Leach, Butterworth and Heinnmamm Ltd.1994.

Subject Name:	Bioseparation Technology				
Paper Code:	**BIOT4102**				
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

<u>Course Outcomes:</u>

1. Students will acquire basic understanding of different bioseparation processes and design principle for commonly used process equipments.
2. Students will obtain knowledge about the basic principles and application of sedimentation, centrifugation and filtration.
3. Students will be able to explain the principles of extraction and membrane based separation of bioproducts and can apply the knowledge for calculations of extraction process.
4. Students will understand the principle of adsorption, chromatography and relation of adsorption with chromatography.
5. They will be able to apply different chromatographic techniques for separation of different Bioproducts.
6. Students will comprehend the knowledge of precipitation, drying, crystallization and will be able to solve numerical problems related to these processes.

Module I: Basic Concepts [10L]
Methodology and overview of bioseparation technology. Basic design principles of separation equipments; Sedimentation – Objectives, principles, sedimentation coefficient, Scale-up based on equivalent time, Bowl centrifuge, tubular centrifuge; Extraction -- Objectives, extraction principles, phase separation and partitioning equilibria, scale-up and design of extractor.

Module II: Fundamental methods: Chromatography, Adsorption and Precipitation [10L]
Chromatography and adsorption -- Objectives, adsorption equilibrium, column dynamics, fixed bed adsorption, related problems. Precipitation -- Objectives, protein solubility, structure, size, charge, solvent, initial mixing, nucleation, growth governed by diffusion, methods of precipitation, design of precipitation system,

Module III: Membrane based separation processes [10L]
Design, Scale-up and biological application of U F, M F and R O.

Module IV: Crystallization, drying and industrial applications of bioseparation techniques [10L]
Principles, fundamental objectives, design and scale-up of cryatallization and drying equipment.

Srabanti Basu

Textbook :

1. Bioseparation Science and Engineering -- Indian Edition Roger G Harrison, Paul Todd, Scott R Rudge and Demerti P Petrides OXFORD University Press.

Reference books:

1. Schuler & Kargi, Bio-process Engg. PHI
2. Bailey & Olis, Biochemical Engg. Fundamentals, McGraw-Hill, 1990
3. Mukhopadhyay, S.N. Process Biotechnology Fundamentals, Viva Books Pvt. Ltd. 2001.
4. Muni Cheryan, Handbook of Ultrafiltration
5. Perry, Chilton & Green, Chemical Engineers' Handbook, McGraw-Hill
6. Ho, W.S.W. & K. K. Sirkar, Membrane Handbook, Van Nostrand Reinhold, N.Y.(1992)

Subject Name:	**Food Biotechnology**				
Paper Code:	**BIOT4141**				
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completing this course, students will be able to:

1. Apply different food preservation techniques.
2. Know different food processing techniques.
3. Analyse different processed food.
4. Application of enzymes in food industry.
5. Detect adulteration and toxic components of food.
6. Gain knowledge on different functional food and GMO

Module I: Food Preservation Technology [10L]
Spoilage of food: fruits, vegetables, meat, milk and milk products, fats and oils.
Food poisoning: Botulism, Staphylococcal intoxication and fungal toxins: disease manifestation and mechanism of action of toxins: Food preservation techniques: physical methods: canning, heating, refrigeration, irradiation, dehydration.

Module II: Food Production Technology [10L]
Fermented and semi fermented food products: Fermentation of fruits and vegetables (e.g., sauerkraut, Dill pickle), dairy products.Production of single cell protein: Mushroom cultivation Genetically modified crop: production technology and safety aspects

Module III: Enzymes in Food Industry [10L]
Enzymes in bakery and cereal products, Enzymes in fruit juice production, Enzymes in fat/oil production, Enzymes in cheese making and beverage production

Module IV: Food Additives, Food Safety and Packaging [10L]
Food preservative: natural and synthetic, Other additives: Food colour, food flavor enhancers, nutritional suppliments, Probiotics, Chemical safety measurement: heavy metals, fungal toxins, bacterial toxins, herbicide, pesticide.

Textbook:

1. Jay, Modern Food Microbiology, CBS Publishers, 1987
2. Frazier, Food Microbiology, Tata McGraw Hill, 2004

References:

1. Meyer, Food Chemistry, CBS Publishers, 2004
2. Shakuntala Manay, Foods: Facts and Priciples, New Age Publication, 2005

Subject Name: Environmental Biotechnology					
Paper Code: BIOT4142					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completing this course, students will be able to:

1. Describe different methods of sampling and controlling air pollutants.
2. Analyze the characteristics of wastewater and understand the principles of physical and chemical treatment of it.
3. Design different processes for biological treatment of wastewater and solve numerical problems related to them.
4. Explain the processes of solid waste management and apply the knowledge in waste to energy conversion.
5. Understand the principle of biodegradation and bioconversion of natural and xenobiotic compounds.
6. Apply the knowledge of bioremediation for controlling and removal of heavy metals in contaminated wastewater.

Module I: Air Pollution: Control Methods and Equipment [10L]
Primary and secondary air pollutants, effects of air pollutants on health, basic ideas of air pollution control equipments- bag filter, electrostatic precipitators, cyclone separators, wet-scrubbers, bio- scrubbers.

Module II: Water Pollution: Control Methods and Equipments [10L]
Sources -- municipal and industrial wastewater. Characterization of wastewater. Treatment principles: primary, secondary, tertiary. Activated sludge process, extended aeration, trickling filter, mechanically aerated lagoons, waste stabilization ponds, upflow anaerobic sludge blanket (UASB) reactor. Common effluent treatment plant- fundamental and case studies. Membrane based treatment processes – fundamental and case studies. Numerical problems on parameters and their determination methods.

Module III: Solid Waste Management [10L]
Sources and types; Treatment: Landfilling, Composting and Vermiculture, Biopiling, Incineration; Energy production from solid waste.

Module IV: Bioremediation [10L]

Preliminary ideas of Bioremediation—in-situ and ex-situ, Biodegradation of xenobiotics, polycyclic aromatic hydrocarbons, Persistent Organic Pollutants (POP), pesticides. Factors affecting the degradation of organics and removal of heavy metals (Mercury, Chromium, Arsenic etc.) by microbes.

Textbook:

1. Rao, C.S., Environmental Pollution Control Engineering, New Age International, 1999
2. S. P. Mahajan, Pollution Control in Industries, TMG

Reference books:

1. Omasa,Air pollution & plant biotechnology, Springer
2. Metcalf & Eddy, Wastewater Engineering – Treatment, Disposal and Reuse, 4th ed., TMG
3. Arceiwala, S.J., Wastewater treatment for pollution control, 2nd Ed. TMH
4. Introduction to Environmental Engineering and Sciences by Gilbert M.

Subject Name: Bioprocess and Process Instrumentation					
Paper Code: BIOT4143					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:

At the end of this course students will be able to:

1. Understand the mechanism of enzyme action on a substrate explicitly.
2. Apply the above concepts to solve problems in the enzyme technology field.
3. Comprehend and solve any problem regarding sterilization of the medium used in fermentation.
4. Compare between a batch process and a continuous process regarding microbial growth.
5. Classify a microbial product and determine its productivity.
6. Appreciate the operation of different process instruments used for measuring various operating parameters of a bioprocess.

Module-I: Principles of enzyme catalysis [10L]
Introduction to enzymes, mechanistic models for simple enzyme kinetics, rate parameters, models for allosteric enzyme kinetics, effect of pH and temperature, methods of immobilization, diffusional limitations in immobilized enzyme systems.

Module-II: Fundamentals of sterilization [10L]
Media for industrial fermentation, medium formulation, medium optimization, Sterilization, design of batch and continuous sterilization process. Effect of operating variables of sterilization on nutrient quality in media. Air sterilization.

Module-III: Mixed Culture kinetics [10L]
Microbial growth kinetics in batch and continuous culture. Product productivity. Introduction, classification. Kinetics and application of mixed culture.

Module-IV; Fundamental of measuring instruments [10L]
Basic principles and operations of measuring instruments for measurement of temperature, flow pressure, DO level.

Text books:

1. Michael Shuler and Fikret Kargi, Bioprocess Engineering: Basic Concepts, 2nd Edition, Prentice Hall, Englewood Cliffs, NJ, 2002.
2. P.F. Stanbury, A. Whitaker, S.J. Hall, Principles of Fermentation Technology. Butterworth-Heinemann, 1995.

Reference Books:

1. Pauline M. Doran. Bioprocess Engineering Principles. Academic Press. 1995.
2. James E. Bailey and David F. Ollis, Biochemical Engineering Fundamentals. Mc-Graw Hill Education. 2^{nd} edition, 1996.
3. Shuichi Aiba, Arthur E. Humphrey & Nancy F. Millis. Biochemical Engineering. Academic Press. 1965

Subject Name: Modeling and Simulation of Bioprocesses					
Paper Code: BIOT4161					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:

At the end of this course students will be able to:

1. Understand the basic concepts of modeling and simulation.
2. Differentiate between modeling and simulation.
3. Classify mathematical models into deterministic and stochastic, structured and unstructured, segregated and non-segregated models.
4. Derive mathematical models for various processes in the biological system.
5. Apply different numerical techniques towards simulation of bioprocesses.
6. Develop mathematical models for a given bioprocess

Module-I: Fundamentals of Modeling & Simulation [10L]
Introduction to modeling and simulation, classification and examples of kinetic models: Deterministic and stochastic, structured and unstructured, segregated and non-segregated.

Module-II: Modeling of Bioprocess-I [10L]
Product formation model; genetically structured models, modeling of extra cellular enzyme production.

Module-III: Modeling of Bioprocess-II [10L]
Modeling of: continuous sterilization of medium; activated sludge process, anaerobic digestion, biochemical reaction with respect to external mass transfer, internal diffusion and kinetics.

Module –IV: Process Simulation techniques in Bioprocess Engineering [10L]
Program-based numerical methods: algebraic equations, Newton Raphson, interpolation, solution of differential equations- Euler method, Fourth order Runga–Kutta method, etc. Application of simulation techniques in bioprocess.

Texts/References:

1. Bailey, J.E and D.F Ollis, Biochemical Engineering fundamentals , 2nd ed. McGraw Hill Book Co. , 1988.
2. Blanch, H.W and I.J. Dunn, “Modeling and Simulation in Biochemical Engg” in Advances in Biochemical Engineering.
3. Michael L. Shuler and Fikret Kargi, “Bioprocess Engineering: Basic Concepts, 2nd Edition”.
4. William L. Luyben, “Process Modelling, Simulation and Control for Chemical Engineers”.

Subject Name: Biomaterials					
Paper Code: BIOT4162					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:

At the end of this course students will be able to:

1. Students will be able to explain the fundamentals of Biomaterials.
2. Students will be able to apply the knowledge of sterilization of Biomaterials in tissue regeneration.
3. Students will be able to illustrate the structure, production process and applications of protein based Biomaterials.
4. Students will be able to describe structure, production process and applications of carbohydrate based Biomaterials.
5. Students will be able to describe structure, production process and applications of industrially important Biomaterials.
6. Students will be able to illustrate the properties of different Biomaterials.

Module I: Fundamentals of Biomaterials [10L]

Fundamentals of biomaterial science: Biocompatibility, types, basic properties and applications of Biomaterials; Disinfection and sterilization of biomaterials; Biodegradable polymers and tissue regeneration scaffolds; Collagen and Fibroin: Structure, production (conventional and cloning method), properties and its use.

Module II: Carbohydrates as Biomaterials [10L]

Carbohydrate (Starch, Alginate, Chitin, Agarose etc.) and modified carbohydrates (modified starch, polydextrose, chitosan etc.): Structure, production, properties and applications.

ModuleIII: Industrial Biopolymers [10L]

Structure, properties, production and applications of polyphenol resins, Polycaprolactone (PCL), Polyhydroxybutyrate (PHB), copolymer of Polyhydroxybutyrate and polyhydrovaleric acid (PHB-PHV), polylactic acid (PLA), Dextran and hyaluronate polymers.

Module IV: Properties of Biopolymer [10L]

Physical properties: Molecular weight of polymers; Mechanical properties: Size, shape, microstructure, texture, porosity, elasticity, viscosity and visco-elasticity; Thermal Properties: Glass transition temperature, thermal diffusivity, coefficient of thermal expansion; Chemical Properties: Solubility and erosion, leaching of constituents, corrosion.

References:

1. Ratledge C and Kristiansen B, Basic Biotechnology, Cambridge University Press, 2nd Edition, 2001
2. Doi Y, Microbial Polyesters, VCH Weinheim, 1990

Subject Name: Proteomics and Protein Engineering					
Paper Code: BIOT4164					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:

After completion of this course, students will be able to

1. Describe different large scale protein separation, estimation, identification and sequencing techniques. Apply the knowledge to solve and analysis of in proteome.
2. Understand the *in vivo* and *in vitro* protein-protein interactions techniques.
3. Describe the techniques for Structural proteomics and apply knowledge of proteomics in drug discovery.
4. Describe the basics and significance of protein engineering; demonstrate the modification and design of protein according to the demand of industry and application.
5. Understand the stability of protein structure and mechanism of protein folding; apply this knowledge in study of protein misfolding related diseases.
6. Analyze and solve problems related to proteomics and protein engineering technology.

Module I: Proteomics [10L]

Introduction to proteomics, Techniques of proteomics: protein separation and quantitation (2D-gel electrophoresis, liquid chromatography), protein identification (mass spectrometry, protein sequencing and others), protein-protein interactions (Yeast two hybrid and others), post translational modification. Application of proteome analysis.

Module II: Structural proteomics and proteomics in drug discovery [10L]

Structural proteomics: Crystallography and X-ray diffraction, NMR spectroscopy, Cryo-EM and others, Proteomics in drug discovery: pharmaceutical proteomics (drug development, drug delivery**),** diseases diagnosis; functional genomics (reverse genetics**,** transcription and replication of negative strand viruses).

Module III: Protein engineering [10L]

Introduction to steps of protein engineering, solid phase peptide synthesis, production of novel proteins; random and site directed mutagenesis; Methods for expressing recombinant proteins. Industrial applications: engineering of protein stability, affinity for substrate, protease specificity, cofactor requirements.

Module IV: Protein stability and folding [10L]

Overview of protein structure, protein stability, protein folding: mechanism, folding kinetics, molten globule, role of molecular chaperones in *E.coli*, Human. Techniques to study protein folding: CD spectroscopy and others. Protein degradation; Protein misfolding and disease state: Prions, Alzheimer's, Cystic Fibrosis and others. Polyketides and non-ribosomal peptides, application of protein folding towards new drug design.

Textbooks

1. R.M. Twyman: Principles of Proteomics, Bioscientific Publishers.
2. Proteins: Structure & Function by David Whitford, Wiley Blackwell Publishers.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) by Glick, Pasternak and Patten, ASM Press.

Reference Books

1. Biochemistry & Molecular Biology Practical by Wilson and Walker.
2. B.Alberts,D.Bray, J.Lewis et al, Molecular Biology of the Cell, Garland Pub. N.Y. 1983.
3. Richard J. Simpson, Proteins and Proteomics, I.K. International Pvt Ltd.
4. Branden, C., Tooze, R., Introduction of Protein structure, Garland, 1st Edition, 1993.
5. Lilia Alberghina., Protein Engineering in Industrial Biotechnology, Harwood Academic pub, 2003.
6. Protein engineering and design by Paul R. Carey, academic press, 1996, 361 pages.
7. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edn. Pearson Education (2007).
8. Primrose & Twyman, Principles of Gene Manipulation and Genomics, 7th Edn, Blackwell (2006).
9. Daniel C. Liebler, Introduction to Proteomics. Humana Press.

Subject Name: Human Genomics					
Paper Code: BIOT4165					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of this course students will be able to

1. Develop a concept of the different genome mapping techniques and the genome assembly methods.
2. Understand the usage of functional genomics tools, different methods of gene transfer and applications of comparative genomics.
3. Understand the background of the Human Genome Project along with its findings on genome anatomy, gene family, gene diversity and gene markers.
4. Analyze the haplotypes and SNPs by various quantitative techniques.
5. Interpret the findings of Human Genome Project in the domain of pharmacogenomics and polygenic disorders.

Module I: Genome mapping and assembly [10L]

Genome mapping techniques: physical and cytologic mapping; Genome sequencing: Clone-by-clone sequencing, Whole genome shotgun sequencing, Hybrid sequencing and high throughput sequencing methods; Gene identification using positional and functional cloning approach; Genome sequence assembly and annotation.

Module II: Functional Genomics and comparative genomics [10L]

Functional genomics tools: sequence based approaches, whole genome alignment.

Comparative Genomics: overview of prokaryotic and eukaryotic genomes, C-value, number of genes and complexity of genomes, conservation and diversity of genomes, lateral gene transfer, role of comparative genomics in gene mapping and study of human disease genes.

Module III: Human genome project and its implications [10L]

HGP: Background, timeline, findings, Ethical Legal and Social Implications (ELSI); Patterns of Genome organization: mitochondrial genome, gene density, CpG islands, RNA encoding genes, functionally identical/ similar genes, diversity in size and organization of genes, gene families; Human genetic diversity study: Biochemical/molecular genetic markers; tracing human migrations with autosomal, Y-chromosomal and mitochondrial markers.

Module IV: Applications of Genomics research [10L]

SNPs and Haplotype maps; Linkage Disequilibrium (LD) and association studies; Quantitative Trait Locus (QTL) mapping; SNP genotyping methods; Personalized medicine and Pharmacogenomics; basics of gene transfer technologies and their applications; Genomic basis of polygenic disorders – diabetes, cardiovascular disease, obesity.

Textbook:

1. Introduction to Genomics. Arthur M. Lesk, 2nd edition, Oxford University Press.

Reference Books:

1. T. A. Brown, Genomes 3, John Wiley & Sons.
2. Singer. M, and Berg. P, Genes and genomes, Blackwell Scientific Publication, Oxford.
3. Primrose and Twyman, Principles of Gene Manipulation and Genomics, 7th edition, Blackwell Publishing Co.
4. Glick and Pasternak, Molecular Biotechnology, Principles and Applications of Recombinant DNA Technology, ASM Press.
5. Cantor & Smith, Genomics, John Wiley & Sons.
6. Strachan & Read, Human Molecular Genetics, 3rd edition, Garland Science.
7. Gibson G. and Spencer V.M. A Primer of Genome Science, 2nd edition, Sinauer Associates Inc.

Subject Name: Biosensors					
Paper Code:BIOT4181					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of this course students will be able to

1. State types of bio-recognition elements and describe the fundamental components required to make a viable biosensor.
2. Illustrate types of enzyme immobilization methods used to make a biosensor and immobilize it to a transducer for the construction of biosensor.
3. Describe each types of biosensing element in relation to their uses in biosensors.
4. Understand the classification, construction and working principle of various transducers.
5. Understand the concepts, types, working principles and practical applications of important biosensors.
6. Explain the working principle of different types of inhibition based biosensors.

Module I: Introduction to biological system and Biosensors [10L]
Biosensor: principle, general characteristics; Proteins and enzymes: basic properties, denaturation and renaturation, immbobilization of enzymes; Advantages and limitations of biosensors; Classification of biosensors based on bioreceptor; Immobilization and coupling of bioreceptors.

Module II: Bio-recognition based sensors [10L]
Principle, operation and limitation of: Microbial sensor, Immunological sensor, Nucleic acid sensor. Other bioreceptors (e.g. animal, plant tissue); Different types of inhibitors: principles, operations, applications and limitations.

Module III: Biosensor based on transducer [10L]
Classification of biosensor based on transducer; Calorimetric, Electrochemical (potentiometric, amperometric), Optical, Piezoelectric, Semiconductor biosensor: principle, construction, calibration and limitations.

Module IV: Application of biosensor [10L]
Clinical and diagnostics sector, Industrial sector: Food, Environmental, defense sector; Commercially available biosensor.

Reference books:

1. Biosensors by Tran Minh Canh. London. Chapman and Hall, 1993.
2. Turner, A.P.F, Karube.I.,and Wilson,G.S, Biosensors Fundamentals and applications, Oxford Univ. Press.
3. Engineering biosensors, kinetics and design applications by Ajit Sadana..San Diego, Academic Press, 2002.
4. D.Thomas and J.M. Laval – Enzyme Technology in concepts in Biotechnology by Balasubramaniam et al, Univ. Press, 1996.

Subject Name: Biopolymers					
Paper Code: BIOT4182					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

At the end of this course students will be able to

1. Students will acquire basic knowledge of biopolymer and can classify biopolymer according to their composition.
2. Students will get familiar with the structures, properties and applications of different protein based biomaterial.
3. Students will be able to explain the structures, properties and applications of different carbohydrate based biomaterial.
4. Students will comprehend the knowledge of different type and applications of bioplastics.
5. Students will learn about the different composite material that can be used as biomaterial. They will be familiar with the applications, advantages and disadvantages of bioplastics and composite materials.
6. Students will classify biodegradable polymer and will analyze the biodegradation techniques.

Module-I: Introduction to biopolymers and protein biopolymers [10L]

Classification of Biopolymers; Collagen, Keratin and Fibroin: Structure, production (conventional and cloning method), properties and its use (Tissue regeneration scaffolds and others)

Module II: 1Carbohydrates as Biomaterials [10L]

Carbohydrate (Starch, Alginate, Chitin, Agarose) and modified carbohydrates (modified starch, polydextrose, chitosan etc.): Structure, production, properties and applications.

Module III: Application of Bioplastics and composite materials [10L]

Definition of bioplastics, Types of bioplastics such as starch-based, cellulose-based plastics and some aliphatic polyesters (PLA, PHB), polyamides, bio-based composites from soybean oil and chicken feathers, bio-derived polyethylene and genetically modified bioplastics. Composite theory of fiber reinforcement (short and long fibers, fibers pull out); applications and limitations of bioplastics and composite materials.

Module IV: Polymer biodegradation [10L]

Classification of biodegradable polymers (Natural, Synthetic and modified naturally modified); Techniques for analysis of biodegradation of polymers- Enzyme assays, Plate test, Respiratory test, Gas evolution test (CO_2 & CH_4), Field trial

References:

1. Ratledge C and Kristiansen B, Basic Biotechnology, Cambridge University Press, 2nd Edition, 2001
2. Doi Y, Microbial Polyesters, VCH Weinheim, 1990.

Subject Name: Renewable Energy Technology					
Paper Code: BIOT4241					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course outcomes:

At the end of this course students will be able to:

1) Distinguish the different types of biomass and explain its uses
2) Explain the conversion of biomass to clean fuels and also conversion of petrochemical substitutes to useful products by physiochemical/fermentation processes
3) Explain how ethanol and methane can be produced from biomass to produce bio-ethanol
4) Describe how biopolymer and biosurfactants can be used for microbial recovery of petroleum
5) Describe and understand how solar energy can be harnessed for useful purposes such as production of photovoltaic cells and for chemical storage purposes
6) Analyze and understand how other renewable energy sources can be harnessed for other productive purposes

Module I: Biomass [10L]

Sources and types of biomass – forest, agricultural and animal residues, industrial and domestic organic wastes, conversion of biomass to clean fuels and petrochemical substitutes by physicochemical and / or fermentation processes.

Module II: Biofuels [10L]

Biogas from anaerobic digestion; ethanol and methane from biomass. Hydrogen production by photosynthetic bacteria, biophotolysis of water. Microbial recovery of petroleum by biopolymers (Xantham gum), biosurfactants.

Module III: Solar energy [10L]

Description and design aspect of solar collectors, solar pond, photovoltaic cell and chemical storage.

Module IV: Other conventional energy [10L]

Introduction to geothermal, wind, tidal wave energy; Use of geothermal energy; Operating principles, application and design aspect of wind energy mills; Nuclear energy- types of nuclear reactors and their safety aspects.

Texts/References:

1. J.E. Smith, Biotechnology, 3rd ed. Cambridge Univ Press
2. S. Sarkar, Fuels and combustion, 2nd ed., University Press.
3. Donald L. Klass, Biomass for renewable energy, fuels and chemicals, Academic Press.

Subject Name: Tissue Engineering:					
Paper Code:	**BIOT4242**				
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course outcomes:

At the end of this course students will be able to:

1. Explain the significance, current status and future potential of tissue engineering, identify requirements of tissue engineering, comprehend the structural organization of cells and tissues, the role of cell interaction, cell migration, wound healing and cellular processes.
2. Identify key challenges in tissue engineering of different human tissues, describe importance of cell signalling, angiogenesis in tissue engineering.
3. Describe the design, fabrication and biomaterials selection criteria for tissue engineering scaffolds.
4. Describe the sources, selection, potential manipulations, storage and challenges of using stem cells for tissue engineering.
5. Use simple models to quantify aspects of bioreactor design in the context of tissue engineering, understand the basics of 3D cell culture.
6. Discuss the challenges of in vivo implantation of biomaterials and scale-up issues relating to human clinical applications and explain the ethical and regulatory issues of significance in tissue engineering.

Module-I: Introduction to Tissue Engineering [10L]
Morphogenesis, generation of tissue in the embryo, Tissue homeostasis, Cellular signaling, extracellular matrix as scaffold for tissue engineering.

Module-II: Polymers in Tissue Engineering [10L]
Applications of natural polymers in tissue engineering, Degradable polymers for tissue engineering, Scaffold design and fabrication, Degradation of bioceramics, Biocompatibility.

Module-III: Cell Cultures in Tissue Engineering [10L]
Cell source, Stem cells, Cell culture harvest selection expansion and differentiation, Cell nutrition, Cryobiology, Bioreactors for tissue engineering.

Module-IV: Applications of Tissue Engineering [10L]
Controlled release strategies in tissue engineering, Tissue engineering for skin transplantation, Tissue engineering of cartilage, bone, nervous system, organ system, Ethical issues in tissue engineering.

Text Book:

1. Tissue Engineering (2008) by C. van Blitterswijk, P. Thomsen, J. Hubbell, R. Cancedda, J.D. deBruijn, A. Lindahl, J.Sohier, D. Williams Academic Press .

Ref. books:

1. Principles of Tissue Engineering (1997) by Robert Lanza, Robert Langer, Joseph P. Vacanti, Academic Press.
2. Tissue Engineering: Roles, Materials and Applications (2008) by Steven J. Barnes, Lawrence P. Harris, Nova publication

Subject Name: Post Harvest Technology					
Paper Code: BIOT4274					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	1	0	4	4

Module I [10L] Cereals and Pulses

Fundamentals of psychometry; fundamentals and methodology of parboiling, drying and milling, hydrothermal treatment of cereal grains and it's changes in physico-thermal and biochemical properties, milling of rice, corn, wheat and pulses.

Module II [10L] Fruits and vegetables

Processing of fruits (banana, watermelon, papaya and mango) and vegetables (tomato, carrot, garlic and onion) processing: methodology of cleaning, product preparation and preservations (CAP and MAP).

Module III [10L] Oil Seeds

Production of edible oil: Processing of oil seeds, extraction and refining of oil from different sources: sunflower, coconut, cotton seed, soyabean; Processing, extraction, refining and stabilization of rice bran.

Module IV [10L] Storage

Storage principles, changes occurring in food grain--chemical, physical and biological, Grain storage, pests and their control, rodent control, food grain storage structures: bag and bulk storage, economics of storage and processing of rice, packaging concepts.

Texts/References:

1. A. Chakraborty, Post harvest technology of cereals, pulses and oil seeds, 1995.
2. G. Boumans, Grain Handlings and storage, Development in Agricultural Engg., Elsevier, Tokyo, 1988.
3. N.S. Rathore, G.K. Mathur, S.S. Chasta, Post-Harvest Management and Processing of Fruits and Vegetables.

Course Name : Metabolic Engineering					
Course Code: BIOT4245					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:
After completing the course, the students will be able to:

1. Understand the overview of cellular metabolism and connection between metabolic pathways.
2. Understand the metabolic pathway regulation at transcription and translation level.
3. Differentiate regulatory mechanisms involved in biosynthesis of primary and secondary metabolites
4. Apply the concept of auxotrophic mutations for the synthesis of primary and secondary metabolites
5. Understand the concept of bioconversions and its applications
6. Understand the concepts for developing heterologous pathways for production of value added compounds

Module-I (10L): Introduction

Induction-Jacob Monod Model, catabolite regulation, glucose effect, camp deficiency, feedback regulation, regulation in branched pathways, differential regulation by isoenzymes, concerted feedback regulation, cumulative feed back regulation, amino acid regulation of RNA synthesis, energy charge, permeability control passive diffusion, facilitated diffusion, active transport group transportation.

Module-II (10L): Synthesis of primary & secondary metabolites

Biosynthesis of Primary Metabolites: alteration of feedback regulation, limiting accumulation of end products, feedback, resistant mutants, alteration of permeability. Biosynthesis of Secondary Metabolites: precursor effects, prophophase, idiophase relationships, enzyme induction, feedback regulation, catabolite regulation by passing control of secondary metabolism, producers of secondary metabolites.

Module-III (10L): Bioconversions

Advantages of Bioconversions, specificity, yields, factors important to bioconversions, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions, conversion of insoluble substances.

Module-IV (10L): Regulation of enzyme production

Strain selection, improving fermentation, recognizing growth cycle peak, induction, feed back repression, catabolite repression, mutants resistant to repression, gene dosage.

Text Books/References:

1. Metabolic Engineering: Principles and Methodologies by Gregory N. Stephanopoulus,
1. Aristos A. Aristidou, and Jens Nielsen.

2. Pathway Analysis and Optimization in Metabolic Engineering by Néstor V. Torres and Eberhard O. Voit.
3. The Metabolic Pathway Engineering Handbook by Christina D. Smolke.
4. Biochemical Engineering by Harvey W. Blanch and Douglas S. Clark.
5. Fermentation and Enzyme Technology (1980) by Wang D. I. C., Cooney C. L., Demain A. L., Dunnil P., Humphrey A. E., Lilly M. D., John Wiles and Sons.,
6. Principles of Fermentation Technology (2005) by Peter, F. Stanbury., Stephen, J. Hall and Whitaker, A. Elsevier,
7. Biochemistry (1999) Zubay, G., McGraw Hill Publishers, 4th Edition,

Subject Name: Medical and Pharmaceutical Biotechnology					
Paper Code: BIOT4246					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: Drug Development [10L]
Principles of drug design and protein modification applied to biopharmaceuticals; pharmacokinetics and pharmacodynamics of biopharmaceuticals; generation of biopharmaceuticals from natural tissues and by recombinant methods (e.g. hormones, interferons, EPO and others); biosmilars; comparison with small molecule drugs; microbial transformations; antibiotics and steroids; techniques for development of new generation antibiotics; formulation, delivery and packaging of small and large molecule drugs.

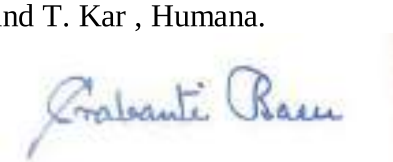
Module II: Disease Diagnosis and Therapy [10L]
Monoclonal antibodies and their applications; CD Markers, FACS, HLA typing, Vaccines – features of an ideal vaccine: conventional and modern vaccine technologies; DNA and RNA based diagnostics and therapeutics: applications in PCR and others; Genotyping: case studies related to bacterial, viral and parasitic infections; Gene Therapy: status, problems and prospects of further development. Pharmacogenomics and Toxicogenomics; Stem cell therapy

Module III: Proteomics in Drug Development [10L]
Role of Proteomics and proteomics derived techniques to drug development; Discovery, analysis, technological developments and future prospects of protein based biomarkers for disease diagnosis (e.g. cancer biomarkers); Separation and identification technologies for proteomics (e.g. CE, HPLC-MS*)*; Enzyme immunoassays: types, their development and applications for clinical diagnosis.

Module IV: Clinical Diagnosis and Kit Development [10L]
Principles of diagnostic enzymology; use of enzymes in clinical diagnosis and kit development; determination; Biosensors: principles, types, clinical and biotechnological applications of biosensors; Noninvasive Biosensors in clinical analysis; Nanotechnological applications in biosensor development; Biochips: Introduction and applications in modern sciences, development of diagnostic kits for micro-clinical analysis.

Textbooks:

1. Biopharmaceuticals-Biochemistry and Biotechnology- By Gary Walsh, 2nd Edition, John Wiley, Inc.
2. Pharmaceutical Biotechnology- 3rd Edition- By R. Sambamurthy and T. Kar , Humana.



Reference texts:

1. Alberghina, Lilia: Protein Engineering in Industrial and Pharmaceutical Biotechnology, Harwood Academic Publishers (2006).
2. Science to Operations: Questions, Choices and Strategies for Success in Biopharma" By Ralf Otto, Alberto Santagostino and Ulf Schrader, McKinsey and Company, Springer- Bonn.
3. Fundamentals of Enzymology-Nicholas C. Price and Lewis Stevens. Pub: Oxford Science Publications.

Course Name : Basic Process Equipment Design					
Course Code: BIOT4247					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:
After completion of this course, student will be able to:

1. Understand the basic idea of heat exchangers.
2. Understand mechanical stands of shell and tube heat exchangers.
3. Describe Basic concept of evaporators.
4. Analyze the design different type of driers.
5. Recognize Operation of different types of separation equipments.
6. Analyze design parameters of mass transfer columns (distillation and absorption).

Module-I Shell and Tube Exchanger for Single Phase Heat Transfer
Classification of heat exchangers, Thermal design considerations, Shell, Tube, Tube pitch, tube-layout and tube-count, Tube passes, Tube sheet, Baffles, Fouling Considerations, Selection of fluids for tube and the shell side
Shell and Tube Exchanger for Two Phase Heat Transfer
Condenser, Types of condensers, Condenser design, Reboilers, Classification of reboilers
Mechanical Standards of Shell and Tube Heat Exchangers
Design pressure and temperature, Materials of construction
Module-II
Evaporator: Introduction, Types of Evaporators, Methods of Feeding of Evaporators, General Design Consideration of Evaporator

TYPE OF EVAPORATORS
Short-Tube Vertical Evaporators, Basket-type Vertical Evaporators, Long-Tube Vertical Evaporators, Falling Film Evaporators, Rising or Climbing Film Evaporators
Forced Circulation Evaporators, Agitated Thin Film Evaporator, Gasketed Plate Evaporator

Methods of Feeding of Evaporators
Forward feed, Backward feed, Mixed feed, Parallel feed

Performance of Evaporators (Capacity and Economy)

Module-III
Dryers: Introduction, Types of Driers, Design Consideration of Driers

Introduction

Physical Mechanism of Drying

Classification of Dryers

Drying Equipment

Batch Type Dryers
Tray Dryer, Pan Dryer, Agitated Vacuum Dryer

Continuous Dryer
Rotary Dryer, Drum Dryer, Flash Dryer, Fluidised Bed Dryer, Screen Conveyor Dryers

Microwave Drying

Supercritical Fluid Extraction and its application to Drying

Selection of Drying Equipment

Module IV
Separation Equipments: General Design Considerations of Cyclone Separators, Centrifuges, Separation Equipments

Introduction

Cycolne Separator
Cyclone performance, Cut diameter, Collection efficiency, Pressure drop

Gas-Liquid Separator

Liquid-Liquid Separator

Gravity Separation

Centrifugal Separation

Process Design of Mass Transfer Column: Distillation and Absorption Column
Introduction
Plate contractors
Definition of tray areas, Plate types, Bubble cap plates, Valve plates, Sieve plate, Selection of tray type

Books:

1. Process Equipment Design by Young Brownell.
2. Joshi's Process Equipment Design 2016 by V.V. Mahajani.
3. Chemical Process Equipment: Design and drawing –2012, By SC Maidargi.
4. Computer aided Chemical Engineering Equipment Design -- BC Bhattacharyya.
5. Introduction to Chemical Equipment Design --- BC Bhattacharyya. CBS Publication.

Subject Name: Computational Biology					
Paper Code: BIOT4281					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:

At the end of this course students will be able to:

1. Acquire basic understanding of structures and functions of different biomolecules.
2. Obtain knowledge about the different metabolic pathways.
3. Explain different biological data and biological databases.
4. Understand classification of databases and how the biological data are stored in those databases.
5. Obtain the knowledge of different algorithms and programming languages to manage biological data.
6. Apply different tools and software for analysis of biological data.

Module-I: Introduction to Biomolecules [10L]

Introduction to biochemistry and molecular biology; Biomolecules: structure, function and metabolic pathways.

Module-II: Scope of Computational Biology [10L]

Definition of computational biology; origin and development of computational biology; Nature and Types of biological data; Data Structures: Sequences (GENbank files), Secondary structures, Super-secondary structures (Motifs), Tertiary structures (Pubchem and PDB structure files); Interaction Networks, Photographic Data: Fingerprints (DNA and MS), Microarray data; Biological databases.

Module-III: Preferred Algorithms, Programming languages and Operating systems [10L]

Principles of Pattern recognition: Use of Hidden Markov Model and Artificial Neural Networks in computational biology; Significance of Python and C/C++; Operating system: Bio-Linux (Selected Bioinformatics packages)

Module-IV: Applications of Computational biology [10L]

Molecular Modeling and Dynamics: introduction to Open MM library; GROMACS as an example of GUI in the public domain; computer based drug design (public domain and proprietary); Mathematical modeling of cell growth kinetics; Embedded systems for computational biology: High throughput data collection, processing and analysis; LC-MS, DNA microarrays and other applications (e.g. mobile microscopy and high throughput micro-PCR); Systems biology and Metabolic Engineering.

Text books:

1. Introduction to Bioinformatics, by Arthur M. Lesk (International Fourth Edition) (2014), Oxford University Press.
2. Essential Bioinformatics, by Jin Xiong, Cambridge University Press (2006).

Reference books:

1. Biochemistry: Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, 7^{th} edition, Academic Press.
2. Introduction to Bioinformatics: T K Attwood, D J Parry-Smith and S. Phukan (2008) Pearson.
3. Fundamentals of Database Systems, 5^{th} Edition, R. Elmasri and S.B. Navathe (2009)
4. Bioinformatics-A Machine Learning Approach- By Baldi and Brunak, 2^{nd} Edition (2006), John Wiley Inc.
5. Dynamics of Proteins and Nucleic Acids: J. Andrew McCammon and Stephen C. Harvey, Cambridge University Press (1998).
6. Molecular Modelling: Principles and Applications-2^{nd} Edition, Andrew R. Leach-Pearson (2016)
7. Molecular Modelling and Drug Design-K.Anand Solomon-1^{st} edition (2011)-MJP Publishers.

Course Name : Non-conventional Energy					
Course Code: BIOT4282					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course outcomes:
At the end of this course students will be able to:

1. Understand the concept and necessity of non-conventional energy as an alternative source of energy.
2. Comprehend and apply the concepts of solar energy to design Photovoltaic cells and wind energy to design wind turbine.
3. Classify and design different biogas production processes.
4. Design a production process for biodiesel.
5. Understand the concept of hydrogen energy as a clean fuel and characterize the hydrogen production process.
6. Comprehend the importance and classification of hydrogen fuel cells.

Module I: Non-conventional energy: Different forms [9L]
Solar energy: Solar energy balance, production of electricity, photovoltaic systems.
Wind Energy: Wind energy conversion systems, power generation. Calculations on wind turbine.
Hydro thermal energy: Basics of hydro thermal energy.
Energy from waves and tides.

Module II: Biogas [9L]
Biomass as a renewable energy source; types of biomass – forest, agricultural and animal residues, industrial and domestic organic wastes.
Classification of biogas production processes: combustion, pyrolysis, gasification and other thermo-chemical processes.
Production of alcohol and biogas from biomass. Biogas from anaerobic digestion.

Module III: Bio-diesel [9L]
Bio-diesel: Fundamentals; Trans-esterification of vegetable oils for biodiesel production; Characterization of biodiesel; Biodiesel from different sources; Economics, current trends and future prospects in usage of biodiesel.

Module III: Hydrogen as energy source [8L]
Hydrogen energy: Hydrogen energy system and analysis; Hydrogen infrastructure; Safety, codes and standards.
Hydrogen production: Electrolysis; Thermochemical; Hydrogen from fossil fuel, biomass and renewable sources of energy. Problems on combustion of fuels.
Hydrogen storage: Carbon storage materials; Metal hydrides and chemical hydrides; Cryogenic hydrogen storage.
Hydrogen fuel cells: Principle, importance and classification.

Texts/References:

1. J.E. Smith, Biotechnology, 3rd ed. Cambridge University Press.
2. S. Sarkar, Fuels and combustion, 2nd ed., University Press.
3. Donald L. Klass, Biomass for renewable energy, fuels and chemicals, Academic Press.

Course Name: Compiler Constructions Lab					
Course Code: CSEN4111					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Course Outcome:
On completion this course, students are expected to
CO1: **Learn** the different Phases of a compiler using various available tools.
CO2: **Optimize** a given program.
CO3: **Learn** to generate an assembly language program equivalent to a source language program.
CO4: **Understand** how to design solutions for complex engineering problems and to design system components or processes that meet the specified needs with appropriate consideration

LIST OF EXPERIMENTS:

In this lab, a given mini–Language MNL will be considered. This language is a simple procedural high-level language, only operating on integer data, with a syntax looking remotely similar to a simple C language syntax. The syntax of the language MNL will be defined by a BNF grammar.

[The detailed BNF notation for MNL will be notified to students later]

Group A:

These experiments are to be implemented using the C language.

1. Develop a lexical analyzer to recognize a few patterns in MNL. (Ex. identifiers, constants, comments, operators etc.).

2. Implement Stack storage allocation strategies.

3. Design Predictive parser for the given language.

4. Design LALR bottom up parser for the above language.

Group B:

These experiments are to be implemented using Flex and Bison tool.

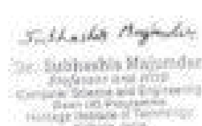
5. Implementation of Lexical Analyzer using Flex Tool.

6. Generate Bison specification for a few syntactic categories.
a) Program to recognize a valid arithmetic expression that uses operator +, – , * and /.
b) Implementation of a simple Calculator.

7. Convert the BNF rules of MNL into Bison form.

Group C:
8. Implementation of Simple Code Optimization Techniques.

9. Explore Code Optimization options implemented in the **gcc** compiler.



COURSE STRUCTURE OF B. TECH IN
COMPUTER SCIENCE & ENGINEERING, HIT

<u> Free Elective Papers offered by Dept. of CSE:</u>**

Theory							
Sl. No	**Course Code**	**Course Name**	**Contact Hrs per Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	CSEN4181	Fundamentals of Operating System	3	0	0	3	3
2	CSEN4182	Intelligent Web and Big Data	3	0	0	3	3

Subject Name: Fundamentals of Operating Systems					
Paper Code: CSEN4181					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module I:
Introduction [5L]:
Operating system Services: Type of services, user view, operating system view
System Structure:
Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services, System calls.
Introduction to Operating System:
Operating system functions, OS Architecture (Monolithic, Microkernel, Layered, Hybrid) , Different types of O.S.: -batch, multi-programmed, time-sharing, real-time, distributed, parallel.
Module II:
Process Management [13L]
Process Management: Process Concept, Process Scheduling, Threads
Processes: Concept of processes, process scheduling, operations on processes, inter-process communication.
Threads: overview, benefits of threads, user and kernel threads.
CPU scheduling: Scheduling concept and algorithms, algorithm evaluation
CPU scheduling : scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority).
Process Synchronization: background, critical section problem, critical region, synchronization hardware.
Deadlocks : system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

Module III:
Storage Management [18L]
Memory Management: Preliminaries, Bare machine, Resident, Monitor, swapping, multiple partition, paging, and segmentations.
Memory Management: background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.
File System: File concept and support, Access and allocation methods, Directory systems, file protection.
File Systems: file concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping
Disk scheduling: Physical Characterization, FCFS scheduling and shortest-seek-time-first.
Disk Management: disk structure, disk scheduling (FCFS, SSTF, SCAN,C-SCAN) , disk reliability, disk formatting, boot block, bad blocks.

Module IV:
Protection & Security [4L]
Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.

Dr. Subhashis Majumder

Course Outcomes:

This course provides a introduction to understand the underlying principles, techniques and approaches used in operating systems lying within a processing system. In particular, the course will consider inherent functionality and processing of program execution. The emphasis of the course will be placed on understanding how the various elements that underlie operating system interact and provides services for execution of application software.

1. Master functions, structures and history of operating systems.
2. Master various process management concepts including scheduling, synchronization, deadlocks.
3. Be familiar with multithreading.
4. Master concepts of memory management.
5. Master system resources sharing among the users.
6. Introduction to file system interface and implementation, disk management.
7. Introduction of protection and security mechanisms.
8. An overview of various types of operating systems including Linux.

References :

1. Milenkovie M., “Operating System : Concept & Design”, McGraw Hill.
2. Tanenbaum A.S., “Operating System Design & Implementation”, Practice Hall NJ.
3. Silbersehatz A. and Peterson J. L., “Operating System Concepts”, Wiley.
4. Dhamdhere: Operating System TMH
5. Stalling, William, “Operating Systems”, Maxwell McMillan International Editions, 1992.
6. Dietel H. N., “An Introduction to Operating Systems”, Addison Wesley.

Subject Name: INTELLIGENT WEB AND BIG DATA					
Paper Code: CSEN4182					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module-1: Intelligent Information Retrieval

Learning from User Interactions – Rating and Voting, E-Mailing and Link Forwarding, Book-marking, Purchasing Items, Customer Reviews

Extracting Intelligence from Tags – Tag-related Meta-data, Tag Generation; Leveraging Tags: Dynamic Navigation, using Tag Clouds, Targeted Search, Recommendations based on Tags

Extracting Intelligence from Contents – Blogs, Wikis, Message Boards

Module-2: Recommendations, Clustering and Classification

Creating Suggestions and Recommendations – Concepts of Distance and Similarity, Recommendations based on Similar Users, Recommendations based on Similar Items; Recommendations based on Contents

Clustering – Overview of Clustering Algorithms

Classification – Need for Classification; Overview, Automatic Categorization of E-Mails and Spam Filtering; Classification and Fraud Detection, Combining Classifiers

Course Outcomes:

This course provides a introduction to understand the underlying principles, techniques and approaches used in operating systems lying within a processing system. In particular, the course will consider inherent functionality and processing of program execution. The emphasis of the course will be placed on understanding how the various elements that underlie operating system interact and provides services for execution of application software.

1. Master functions, structures and history of operating systems.
2. Master various process management concepts including scheduling, synchronization, deadlocks.
3. Be familiar with multithreading.
4. Master concepts of memory management.
5. Master system resources sharing among the users.
6. Introduction to file system interface and implementation, disk management.
7. Introduction of protection and security mechanisms.
8. An overview of various types of operating systems including Linux.

References :

1. Milenkovie M., "Operating System : Concept & Design", McGraw Hill.
2. Tanenbaum A.S., "Operating System Design & Implementation", Practice Hall NJ.
3. Silbersehatz A. and Peterson J. L., "Operating System Concepts", Wiley.
4. Dhamdhere: Operating System TMH
5. Stalling, William, "Operating Systems", Maxwell McMillan International Editions, 1992.
6. Dietel H. N., "An Introduction to Operating Systems", Addison Wesley.

Subject Name:	**INTELLIGENT WEB AND BIG DATA**				
Paper Code:	**CSEN4182**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Module-1: Intelligent Information Retrieval

Learning from User Interactions – Rating and Voting, E-Mailing and Link Forwarding, Book-marking, Purchasing Items, Customer Reviews

Extracting Intelligence from Tags – Tag-related Meta-data, Tag Generation; Leveraging Tags: Dynamic Navigation, using Tag Clouds, Targeted Search, Recommendations based on Tags

Extracting Intelligence from Contents – Blogs, Wikis, Message Boards

Module-2: Recommendations, Clustering and Classification

Creating Suggestions and Recommendations – Concepts of Distance and Similarity, Recommendations based on Similar Users, Recommendations based on Similar Items; Recommendations based on Contents

Clustering – Overview of Clustering Algorithms

Classification – Need for Classification; Overview, Automatic Categorization of E-Mails and Spam Filtering; Classification and Fraud Detection, Combining Classifiers

Module-3: Introduction to Hadoop

Starting Hadoop; Components of Hadoop: HDFS, Working with files in HDFS; Introduction to MapReduce; Streaming in Hadoop; Advanced MapReduce: Chaining MapReduce Jobs, Joining Data from Different Sources; Developing MapReduce Programs in Local Mode and Pseudo-distributed Mode; Moving Data into and out of Hadoop; Data Input and Output in MapReduce; Applying MapReduce Patterns to Big Data; Streamlining HDFS for Big Data

Module-4: Algorithms Using MapReduce

Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce; Matrix Multiplication

Dr. Subhashis Majumder

Course Outcome

- Web Intelligence is a fast-growing area of research that combines multiple disciplines including artificial intelligence, machine learning, data mining, natural language processing.
- Making the Web intelligent is the art of customizing items in response to the needs of the users. Predicting users' behaviors will expedite and enhance browsing experience, which could be achieved through personalization.
- The first half of the curriculum will provide the students with a platform which will give them an introduction to the subject, and will empower them to find the most appropriate and best information for their interest.
- Hadoop and MapReduce are useful tools to work with Big Data. Hadoop is a free, Java-based programming framework that supports the processing of large data sets in a distributed computing environment; MapReduce is a core component of the Apache Hadoop software framework.
- The second half of the curriculum gives students an introduction to the use of Hadoop and MapReduce.

Text Books:

1. Algorithms of the Intelligent Web by H Marmanis and D Babenko from Manning Publishers, 2009
2. Collective Intelligence in Action by S Alag from Manning Publishers, 2009
3. Hadoop in Action by Chuck Lam from Manning Publishers, 2011
4. Hadoop in Practice by Alex Holmes from Manning Publishers, 2012
5. Mining of Massive Datasets by Jure Leskovec, Anand Rajaraman, Jeff Ullman from Cambridge University Press, 2011

Reference Books:

1. Mining the Web: Discovering Knowledge from Hypertext Data by Chakrabarti from Morgan-Kaufmann Publishers, 2002
2. Recommender Systems Handbook by Francesco Ricci, Lior Rokach, Bracha Shapira, Paul B. Kantor from Springer, 2011.

CSEN4281 Fundamentals of RDBMS

Course Outcome: At the end of the course, the students will be able to:

1. Differentiate database systems from file systems by enumerating the features provided by database systems and describe each in both function and benefit.
2. Master the basic concepts and understand the applications of database systems.
3. Demonstrate an understanding of the relational data model.
4. Construct an Entity-Relationship (E-R) model from specifications and to perform the transformation of the conceptual model into corresponding logical data structures.
5. Understand the basic database storage structures and access techniques.
6. Distinguish between good and bad database design, apply data normalization principles, and be aware of the impact of data redundancy on database integrity and maintainability.
7. Construct queries and maintain a simple database using SQL.
8. Apply database transaction management and database recovery.

Introduction

General introduction to database systems; Database - DBMS Definition, approaches to building a database, data models, three-schema architecture of a database, challenges in building a DBMS, various components of a DBMS.

Relational Data Model:

Concept of relations and its characteristics, schema-instance, integrity constraints, E/R Model - Conceptual data modeling - motivation, entities, entity types, various types of attributes, relationships, relationship types, E/R diagram notation. Extended E/R Model, Converting the database specification in E/R and Extended E/R notation to the relational schema.

Data Storage and Indexes - file organizations, primary, secondary index structures, hash-based indexing, dynamic hashing techniques, multi-level indexes, B+ trees.

Relational Query Language:

Relational Algebra operators: selection, projection, cross product, various types of joins, division, example queries, tuple relation calculus, domain relational calculus. Introduction to SQL, Data definition in SQL, Table, Key and Foreign key definitions, Data manipulation in SQL. Nested queries, Notion of aggregation, PL/SQL.

Relational Database Design:

Dependencies and Normal forms - Importance of a good schema design, problems encountered with bad schema designs, motivation for normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization. basics of multi-valued dependencies and 4NF, join dependencies and definition of 5NF.

Transaction Processing:

Concepts of transaction processing, ACID properties, concurrency control, locking based protocols, recovery and logging methods.

Text Books:

1. Database System Concepts by Silberschatz, Korth & Sudarshan (McGraw-Hill Education)
2. Fundamentals of Database System By Elmasari & Navathe- Pearson Education

Reference Book

1. Database Management Systems by RamaKrishna & Gehrke (McGraw-Hill Education)
2. Fundamentals of Relational Database management Systems by Sumathi & Esakkirajan, Springer
3. Date C. J., “Introduction to Database Management”, Vol. I, II, III, Addison Wesley.
4. Ullman JD., “Principles of Database Systems”, Galgottia Publication.

Department of Humanities

Syllabus

Paper Name: Project Management

Paper Code: HMTS-4202

Contact Hours: 2L/week

Credit: 2

Course Outcome:

On completion of this course student will be able to

- ♣ Manage the selection and initiation of individual projects and the portfolios of projects in the enterprise
- ♣ Conduct project planning activities that accurately forecast project costs, timelines, and quality
- ♣ Demonstrate effective project execution and control techniques that result in successful projects
- ♣ Conduct project closure activities and to obtain formal project acceptance
- ♣ Demonstrate a strong working knowledge of ethics and professional responsibility
- ♣Demonstrate effective organizational leadership and change skills for managing projects, project teams, and stakeholders

Detailed Syllabus

Module 1

Introduction: Indian Project Management Scenario: Concept of a Project & subsequent development, characteristics, importance of project management, external causes for delay of a project, internal constraints, how to avoid overruns

Project Planning: Capital investments- importance & types, phases of capital budgeting, levels of decision making, facets of project analysis, feasibility studies

Project scheduling: Importance of project scheduling - work breakdown structure and organization breakdown structure, scheduling techniques- Gantt chart and project control by line of balance (LOB|

Network Analysis: objectives, concept, Programme Evaluation & Review Technique (PERT): Construction of PERT, Slack & critical activities

Critical Path Method (CPM): Genesis of CPA (Critical Path Analysis), Event oriented or activity oriented networks, construction of CPM

Module2

Crashing: concepts & need for crashing; Aspects of Time Cost Trade –off-Analysis, Optimum Project Duration , Effective project cost control

Suparna Chakrabarti

Resource Monitoring and Control: Resource constraints, resource leveling, , integrated resource management

Project Life Cycle (PLC): Methodology, Phases, Graphical representation of time line and level of effort for a project

Module3

Dynamics of Project Cost : Capital costs , Costs pertaining to the pre-investment / investment phase, costs pertaining to operational phase , Capital cost-time-value (CTV) system, economic study estimates, project life cycle costing, project cost reduction methods

Project Quality Management: concept of project quality, Inspection & TQM in projects, standardization

Project Audit: Definition & scope, objectives; Project Auditor's role, contract baseline

Module 4

Project Management Software: Overview of types of software for projects -MS Project, Web based; criteria for software selection, computer PERT simulation

Characteristics of project management software: collaboration, scheduling, issue tracking, project portfolio management, document management, resource management

Recommended Books:

1. Text Book of Project Management, Macmillan by GopalkrishnanP. and Rama M Moorthy
2. Project Management, New Age International Publishers by K Nagarajan
3. Projects –Planning, Analysis, Financing, Implementation , and Review, Tata McGraw-
   Hill Publishing Limited by Prasanna Chandra

Suparna Chakraborti

First Year Syllabus

HOD, ECE Department
Heritage Institute of Technology
Kolkata

First Year, First Semester:

Course Title: Antenna and Radiating Systems					
Course Code : ECEN5101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

Students will come to know about:

1. Antenna – Radiation, VSWR, aperture and their importance.

2. Types of antennae and antenna arrays including microstrip antenna.

3. Testing principles of antennae.

4. EMI and EMC and associated hazards.

5. Different propagation phenomena.

6. QoS of radio links and their analysis.

Module- I [8L]
A. Review of Maxwell's Equation; Radiation of e.m waves and introducing Antenna; Vector Potential and Retarded Vector Potential; Radiation fields of a Hertzian dipole(electric); Duality Principle, Radiation fields due to short magnetic dipole.
B. Antenna Characteristics: Radiation Pattern, Beam Width; Radiation Resistance and efficiency; Directivity and Gain; Impedance, VSWR, Polarization; Effective height and Receive Aperture; Noise Temperature of Antenna

Module- II [8L]
A. Review of basic wire based antennas, Characteristics and properties of : Travelling Wave Antenna, Helical Antenna, Folded Dipole, Yagi-Uda Array, Loop Antenna, Electrically Short Antennas, Broad Band Antenna
B. Antenna Arrays: electric Field due to 2 element arrays, N element Arrays; Pattern Multiplication; Phased array.

Module- III [8L]
.
A. Radiation from apertures, general formulas for scattering and diffraction in and effective area of apertures. Different kind of aperture antennas. Reflector antennas. Appropriate methods for solving reflector antenna problems. Primary feed system design.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

B. Microstrip Antenna(MSA),Active Integrated MSA, Compact MSA with enhanced gain, Broadband Antenna(MSA), Dual frequency & Dual polarized MSA Application of broadcasting, microwave links, satellite communication and radio astronomy.

Module- IV [8L]

A. Methods of Propagation: Ground Wave Propagation, Components of ground wave, Field strength dependence on physical factors. Sky wave Propagation;Space wave propagation. Friis Transmission Formula, SNR of a Radio Link.

B. Basic Terms and Definitions, A Summary of EMI and Related instruments, Error Analysis, Conducted Emission Test procedures, Radiated Emission Test Procedures, Radiated – Susceptibility Test Procedures. LISN

.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

References:

1. R.E Collin, Antennas & Radio wave propagation (McGraw-Hill Book Co.)
2. Jordan and Balmain, Electromagnetic Waves and Radiating Systems (PrenticeHall of India)
3. M.L Skolink, Introduction to radar systems (McGraw-Hill Book Co.)
4. P Bhartia and I.J. Bhal, Millimeter wave Engineering & Applications
5. Albart Smith, Radio Engineering Principle and Applications
6. M. Dolukhanov, Propagation of Radio Waves (Mir Publication)
7. R.Garg,P.Bhartia,Indu Bhal,A.Ittipibom ; Microstrip Antenna Design hand book –Artech House
8. Girish Kumar & K.P.Roy—Broad band Microstrip Antenna-=Artech. House
9. Kin. Lu. Wong ; Compact and Broadband Microstrip Antenna—John Willey & Sons.

Course Title: WIRELESS and MOBILE COMMUNICATION					
Course Code : ECEN 5102					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

1. The students will understand the challenges of wireless and mobile communication.

2. They will be able to analyse the factors like fading, SNR.

3. The students should be able to explain the working of a cellular system- both GSM and CDMA.

4. They will have knowledge about protocols like TCP/IP.

5. The students will be able to apply suitable routing for a transfer.

6. They will be able to analyse performance of cellular and other wireless networks.

Module I: [8 L]

Introduction - evolution of wireless and mobile radio communications, mobile radio systems around the world, trends in cellular radio and personal communication, first generation (1G), second generation (2G), third generation (3G) and 4G mobile cellular networks, Concept of SDR and UMTS.

Cellular concept – Limitations of conventional mobile system, Introduction to mobile cellular communication, concept of frequency reuse, cluster size, cellular system architecture, channel assignment strategies, call handoff strategies - hard

handoff and soft handoff, prioritizing handoff; interference and system capacity, improving capacity in cellular systems – cell splitting, sectoring, microcell zone concept.

Module II: [10 L]

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Different mobile communication systems – GSM services and features, system architecture, GSM radio subsystem, GSM channel types, location updating and call setup, WAP, SCSD, GPRS, EDGE, 3G W-CDMA; CDMA digital cellular standard, comparison between GSM and CDMA, 3G CDMA 2000, IMT-2000.

Module III: [10 L]

Radio Channels and their Characterisation – Different propagation models – Hata , Okimura models, Free space propagation, Multipath propagation, diversity techniques, Co-channel interference, Propagation effects - scattering, ground reflection, fading, Log-normal shadowing.

Wireless networks – Advantages and applications of Wireless LAN, WLAN technology – RF and IR wireless LAN, diffuse, quasi diffuse and point-to-point IR wireless LAN, IEEE802.11 and its architecture, Physical layer, MAC layer, Introduction to WIFI, HIPERLAN2, Bluetooth – Bluetooth architecture.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module IV: [6 L]

Mobile network and transport layer – Introduction to Mobile IP, requirements, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimization, Reverse tunneling; Mobile adhoc networks – Routing, Destination sequence distance vector, Dynamic source routing and Alternative metrics; Traditional TCP – Congestion control, Slow start, Fast retransmit / fast recovery, Implications of mobility; classical TCP improvements – Indirect TCP, Snooping TCP, Mobile TCP,Fast retransmit.

Future of mobile communication – 3G to 4G.

References:

1. Theodore S. Rappaport, Wireless communications: principles and practice, PHI / Pearson education.

2. J. Schiller, Mobile communications, Addison-Wesley.

3. William C. Y. Lee, Mobile cellular telecommunication – analog and digital systems, McGraw Hill, 2nd ed.

4. Wang, Wireless communication System, Pearson Education

5. Talukdar, Mobile computing, TMH

6. J.W.Mark, W. Zhuang, Wireless Communication and Networking, PHI

7. A. Santamaria et al, Wireless LAN systems, Artech House.

8. Stallings, Wireless Communication & Networks, Pearson Education

9. K. Feher, Wireless digital communications, Prentice Hall of India.

9. Roy Blake, Wireless communication technology, Thomson Delmer.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title : WIRELESS AD HOC AND SENSOR NETWORKS					
Course Code : ECEN5131					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:

1.Students will develop the ability to apply knowledge of mathematics, science and engineering in the areas of communication engineering.

2. They will be able to analyze a situation and interpret a data in ad hoc networks.

3. Students will acquire knowledge to learn and apply modeling based approach through the extensive use of simulator tools.

4. Students will be able to understand and develop ability to participate in research work.

5. They will be able to apply suitable algorithm for a route.

6. The students will understand the security requirements for networks.

Module I: [10 L]

Ad hoc wireless Network: Introduction, Basic concept on ad hoc network, static and mobile ad hoc network, transmitter-receiver constraints, Applications.

MAC protocol: Hidden terminal, Exposed terminal, IEEE802.11 in ad hoc mode.

Routing protocols: Proactive, Reactive and hybrid routing protocol, Destination sequenced distance vector algorithm, Dynamic source routing, Ad hoc on-demand routing, Location aided routing, Link reversal routing.

Module II: [10L]

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Analysis of TCP performance in wireless ad hoc network: TCP window management and problems, different solution schemes, QoS in wireless ad hoc network – analysis of degradation of receiver sensitivity, practical solutions.

Achieving energy efficiency in wireless ad hoc network: Different schemes to increase the lifetime of the node in ad hoc network – MAC layer protocol, Routing protocol.

Module III: [8 L]

Localization Management: Location acquisition technique, location sensing technique, location aware routing protocol. Primary and secondary source , Different principles like weighted centriod algorithm to locate sources. Security for wireless ad hoc network: Security goals, threats and challenges, Different schemes of security in ad hoc network, routing security. Spectrum utilization – Generic Access Network (GAN) and other methods

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module IV: [6 L]

Sensors- sensor networking, WSN, hardware and software platforms, OS for WSN, distributed sensor network, healthcare monitoring, environmental sensing, industrial monitoring, smart city concept.

Reading:

1.”Ad Hoc Wireless Networks – Architectures and Protocols” - C.Siva Ram Murthy and B.S. Manoj – Pearson Education

2.Mobile Ad Hoc Networking – Stefano Basagni, Marco Conti, Silvia Giardano, Ivan Stojmenovic – Wiley India

3.”Ad Hoc Mobile Wireless Networks : Principles Protocols and Applications” – Basavaraju – Aurbach Publications

4.Security and Quality of Service in Ad Hoc Wireless Networks – Amitabh Misra – Cambridge University Press

5.”Ad Hoc Mobile Wireless Networks – Protocols and Systems” - Chai K. Toh – Prentice Hall

Course Title: PHOTONICS AND OPTICAL COMMUNICATION NETWORKS					
Course Code : ECEN5132					
Contact Hours per week	L	T	P	Total	Credit Points
	4	0	0	4	4

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

1. Students will know about the different modes, devices,detectors, amplifiers using optical fiber communication.

2. They will have knowledge about various types of systems with their strengths and weaknesses.

3. The students will know about different types of optical networks.

4. They will understand the requirements of repeaters and amplifiers and their parameters.

5. The students will be able to choose type of fiber for typical applications.

6. They will be able to integrate the fiber optics with other networks.

Module I: Photonics: [10 L]

o Introduction to Photonic materials and Photonic Devices.

o Optical waveguides., Optical Fiber Modes and Configurations

o Optical fibers - application specific optical fibres, Photonic Bandgap Optical Fibers.

o Graded Index and Single Mode Fibers.

o Optical couplers;

o Fiber.Bragg gratings

o Electro-optic devices

o Semiconductor lasers and light-emitting diodes

o Photodetectors PIN, Photodiodes and Avalanche Photodiodes.

o Optical Amplifiers- doped fiber amplifier.

Module II: Optical Communication: [8 L]

o Analog and Digital Optical Transmitters and Receivers concepts,

o Loss- limited and dispersion- limited lightwave systems,

o Long-haul systems with In-Line Amplifiers,

o Dispersion compensation techniques in optical communication systems,

HOD, ECE Department
Heritage Institute of Technology
Kolkata

o Power budget and rise-time.

Module III: Coherent lightwave systems: [8 L]

o Modulation and Demodulation schemes for coherent communication,

o System performance issues.

Multichannel Lightwave systems:

o WDM components and devices,

o Multiplexing techniques and system performance considerations.

Module IV: Optical Networks: [10 L]

o Network topologies,

o SONET/SDH,

o Broadcast-and- Select WDM Networks- single-hop networks, multihop Networks,

o Wavelength routed networks,

o Photonic packet switching

o Soliton Communication

References:

1. Keiser, G. , Optical Fiber Communications, Mcgraw Hill

2. John Senior, Optical Fiber Communications: Principles and Practice, Prentice Hall

3. Ajoy Ghatak & K. Thyagarajan, Cambridge University Press

4. Govind R. Agrawal, Fiber Optic Communication Systems, Wiley

Course Title: STATISTICAL PROCESS IN COMMUNICATION					
Course Code : ECEN5133					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

1. Students will know about the different matrices and filters used in communication systems.

2. They will have knowledge about modeling of signals.

3. The students will know about techniques of detection.

4. The students will be able to differentiate between filters.

5. They will learn about signal properties and processes.

6. The students will learn about stochastic models for possible application.

Module I: [10 L]

Revision of linear algebra:

Special matrix forms – diagonal matrix, exchange matrix, triangular matrix, Toeplitz matrix, Hankel matrix, symmetric matrix,

parametric matrix, centro symmetric matrix.

Eigen values, Eigen value solutions.

Random process:

Definition and description of random processes with practical examples.

Time average, ensemble average, covariance, autocorrelation, cross correlation.

Stationary process, ergodic process, WSS process, power spectrum of random processes.

Filtering of random processes – filtering of white noise, spectral shaping filter, spectral factorization.

Special random processes – Autoregressive moving average process, autoregressive process, moving average process, harmonic process.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module II: [10 L]

Signal modeling:

Least square method, Pade approximation method, filter design using Pade approximation, Prony's method of signal

modeling, filter design using Prony's method, FIR least square inverse filter, iterative prefilters,

Stochastic models – ARMA model, AR model, MA model.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module III: [9 L]

Binary symmetric channel:

Principle, properties, bit error properties.

Theories and hypothesis:

Decision theory, Bay's likelihood ratio, ideal observer strategy, Neyman-Pearson strategy, Bay's strategy for single and multiple sample values, optimum linear estimation composite hypothesis testing, optimum detection with incomplete knowledge of the signal, adaptive detection and estimation.

Module IV: [9 L]

Filters:

Principle of optimum filter, matched filter, achievable bit error rate.

FIR Wiener filter – principle and design.

Linear prediction in noise, noise cancellation

IIR Wiener filter – causal, non causal.Kalman filter.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

References:

1. Digital communication, 4th ed. - J. G. Proakis, MGH International edition.

2. Digital and Analog Communication Systems, 7th ed. – Leon W. Couch, PHI.

3. Digital Communication – Zeimer, Tranter.

4. Statistical digital signal processing and modeling, - Monson N. Hays – Wiley.

Course Title: SATELLITE COMMUNICATION and APPLICATIONS					
Course Code : ECEN5141					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

1. Students will know about the orbits and different modules of a satellite.

2. They will have knowledge about satellite links and various factors affecting the QOS of the links.

3. The students will be able to explain the differences between TDMA, FDMA, DAMA etc. access techniques.

4. They will be able to explain VSAT. GPS.

5. The students will be able to analyse causes of interference and solution.

6. They will understand GPS working.

Module I: [8 L]

Introductory topics**:**

A brief history of satellite communication, future scope and present scenario.

Orbital Mechanism: Orbits, look angle, orbital period and velocity, azimuth and orbital inclination, coverage angle, orbital perturbation, mechanism of satellite placement in geostationary orbit. Indian Satellite scenario.
Satellite Subsystems: Communication, telemetry, tracking & command, power, attitude & orbital control, antenna subsystems.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module II: [10 L]

Earth Station: Fundamentals & general system architecture, Earth station antenna, gain, poynting loss, G/T variation and it's measurement, antenna tracking, power amplifier, low noise amplifier, up converter, down converter, transponder hopping, polarization hopping, redundancy configuration.

Satellite transponder: transponder model, transponder channelization, Transponder frequency plans, Effect of fading.

Satellite Link Design: Basic link analysis, interference analysis and attenuation due to rain, link with and without frequency reuse.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module III: [9 L]

Multiple Access Techniques:

Frequency Division Multiple Access: SPADE, FDM-FM-FDMA, Companded FDM-FM-FDMA and SSB-AM-FDMA, intermodulation products in FDMA, optimized carrier-to-intermodulation plus noise ratio.

Time division Multiple Access: Principle, TDMA frame structure, TDMA Burst structure, TDMA Superframe structure, Frame acquisition and synchronization. TDMA timing. Demand Assignment Multiple Access and Digital Speech interpolation. ERLANG B Formula. Type of demand assignment, DAMA characteristics, Real time frame reconfiguration, DAMA interfaces, SCPC-DAMA, Digital Speech interpolation. Satellite packet communication.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module IV: [9 L]

Propagation effects: Propagation effects and their impact on satellite earth link.

Introduction to VSAT systems: low earth orbit and non-geostationary satellite systems. Direct broadcast Television and Radio. Satellite Navigation and the global positioning system. Network configuration, multi-access and networking, network error control, polling VSAT network.

Mobile satellite network: Operating environment. MSAT network concept, CDMA MSAT relink.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

References:

1. Tri T. Ha, Digital Satellite Communication, TMH.

2. Timothy Pratt, Charles Bostian, Teremy Allnutt, Satellite Communication, John Wiley & Sons.

3. J. J. Spilker, Jr., Digital Communication by Satellite, Prentice Hall.

4. Bruce R. Elbert, Satellite Communication Applications Hand Book, Artech House

Course Title: MULTIMEDIA COMMUNICATION					
Course Code : ECEN5142					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD. ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

1. Students will know about the different media classification, media characteristics.

2. They will have knowledge about various types of compression coding and memory systems.

3. The students will know about different architectures used and media modeling.

4. They will learn about management of resources and project management.

5. The students will be able to analyse synchronization problems.

6. They will be producing films with confidence.

Module I: [10 L]

Multimedia Introduction: Media and Data Streams, Classification of media and Properties of multimedia system. Sound, Images & Video : Speech synthesis, Speech Recognition, Raster display, Image recognition, TV, HDTV, Speech transmission, Image transmission.

Module II: [10 L]

Compression : Huffman Coding, Runlength coding, JPEG, MPEG, DVI, H.261

Storage Media : CDDA, CDROM, CDROM (XA)

Multimedia Operating system: Resource Management, Process Management: EDF

Module III: [9 L]

Rate monotonic Algorithms. System Architecture: Quick Time, MDBMS.

Synchronization: Lip & Pointer Synchronization, Synchronization Reference Model, Case Study.

Module IV: (9 L)

Multimedia Communications: Delay compensation, QoS negotiation protocols, Architectures and Issues for Distributed Multimedia Systems, Prototype Multimedia systems: Video-on-Demand, Video conferencing. Multimedia Information: Delay-sensitive and Time-based Media data Modeling

HOD. ECE Department
Heritage Institute of Technology
Kolkata

References:

1. Ralf Steinmetz and KlaraNahrstedt, “Multimedia: Computing, Communications and Applications”, Prentice Hall PTR, 1995.

2. Franklin Kuo, Wolfgnag and J.J. Garsia, “Multimedia Communications, Protocols and Applications”, Prentice Hall PTR 1998.

Course Title: CRYPTOGRAPHY AND NETWORK SECURITY					
Course Code : ECEN5143					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD. ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

1. Students will know about the basics and different standards used.

2. They will have knowledge about important cryptography techniques.

3. The students will know about algorithms applied for encryption.

4. They will acquire knowledge about security challenges and some concepts in web security.

5. The students will understand security systems using VPN and Firewalls.

6. They will be able to develop new algorithms.

Module I: [12 L]

Introduction: Principles of security, Overview of network security and cryptography, OSI Security architecture, model for network security, classification of attacks (Reply, Reflection, Man – in – the – middle), Virus, Worm, Trojan Horse, Spam etc.

Symmetric ciphers: Algorithm types and modes, classical encryption techniques, block ciphers and Data Encryption Standard (DES), Advanced Encryption Standard (AES), Contemporary Symmetric Ciphers, and confidentiality using symmetric encryption

Module II: [9 L]

Public Key Cryptography: Public key Infrastructure (PKI), RSA, key management, Diffe-Hellman key exchange, elliptic curve arithmetic, elliptic curve cryptography.

Message Authentication and Hash Functions: Authentication requirements, authentication functions, message authentication codes

HOD. ECE Department
Heritage Institute of Technology
Kolkata

Module III: [9 L]

Hash functions, security of Hash functions and MACs. Hash Algorithms: MD5 Message Digest Algorithm, Secure Hash Algorithm, Digital Signature Algorithm, Digital Signature Standard. Network Security Applications: Authentication Applications (Kerberos), Electronic Mail Security (SMIME), IP Security (IPSec)

Module IV: [8 L]

Web Security (SSL and TLS), E – cash and Secure Electronic Transaction (SET), System security using Firewalls and VPNs. Advance Applications of Network Security: Smart cards and security, Enterprise Application Security, Biometric Authentication, Database Access Control, Security and Privacy Issues in RFIDs

.

References:

1. William Stallings, Cryptography and Network Security—Principles and Applications, Pearson Edu.

2. Atul Kahate, Cryptography and Network Security, Tata McGraw Hill.

3. Trappe & Washington, Introduction to Cryptography with Coding theory, Pearson Education.

4. William Stallings, Network Security Essentials, Pearson Education.

5. Kaufman, Perlman & Speciner, Network Security, Pearson Education.

6. Behrouz A. Forouzan, , Cryptography and Network Security, McGraw – Hill

Course Title :Antenna and Radiating Systems Laboratory					
Course Code : ECEN5151					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcomes:

Students will know about the different experimental set-ups to measure various parameters related to antennae. They will study radiation pattern for antenna, will acquire practical knowledge about Smith chart and stub matching. The students will also learn to study spectral analysis of signals.

At least, 8 experiments are to be carried out.

1. Plotting of Standing Wave Pattern along a transmission line when the line is open-circuited, short-circuited and terminated by a resistive load at the load end.

2. Measurement of Input Impedance of a terminated coaxial line using shift in minima technique.

3. Study of Smith chart on MATLAB platform.

4. Simulation study of Smith chart - Single and double stub matching.

5. Radiation Pattern study of dipole antenna.

6. Radiation Pattern study of a folded-dipole antenna.

7. Radiation pattern study of Helical Antenna.

8. Parametric study (Gain, Directivity, HPBW and FNBW) of three, five and seven element Yagi Uda configurations.

9. Radiation pattern study of a Pyramidal Horn Antenna.

10. Spectrum analysis of different analog signals (sine, triangular, square) using spectrum analyzer.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title : Wireless and Mobile Communication Laboratory					
Course Code : ECEN5152					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcomes:

- The students will be able to correlate different theories of wireless communication and fiber optics with practical experiments
- They will understand operations of repeater station, GPS and GSM cellular systems
- They will learn the procedures for testing radio parameters
- Students will learn working of fiber optic links
- They will understand bending losses, NA

<u>List of Experiments:</u>

1. Study of working of Repeater stations with the help of Satellite communication system

2. Study of Global system for Mobile (GSM) system along with waveforms of different timing signals

3. Study of Global Positioning System (GPS) and plotting of active satellites with SNR etc.

4. Measurement of some important receiver parameters of a radio receiver like:

i) SNR ;ii) Distortion with ISM band radio.

5. Measurement of some important transmitter parameters of a radio receiver like:

   VSWR for i) different antennae and ii) at different frequencies with ISM band radio.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

6. Measurement of propagation loss, bending loss and connector loss in an optical fiber

7. Study of LASER characteristics

8. Measurement of wavelength of an optical fiber source

9. Study of a fiber optic analog link, study of PAM

10. Study of Frequency Division Multiplexing (FDM) and De multiplexing

11. Study of a fiber optic data link and study of TDM

12. Measurement of numerical aperture of an optical fiber

HOD, ECE Department
Heritage Institute of Technology
Kolkata

At least, 8 experiments are to be carried out in the semester.

Course Title : Research Methodology & IPR					
Course Code : ECEN5103					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	**0**	**0**	**2**	**2**

Research Methodology and IPR

Course Outcomes:

At the end of the course, students will be able to

1. Understand research problem formulation
2. Analyze research related information
3. Follow research ethics
4. Understand the ultimate importance of ideas, concept and creativity
5. Importance of IPR for individuals and nations
6. Appreciate that IPR protection provides incentive to inventors for further research work

Syllabus Contents:

Module I (6L)

Meaning of research problem, Sources of research problem, Criteria and characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problems, data collection, analysis, interpretation, necessary instrumentations.

Module II (6L)

Effective literature studies approaches and analysis

Plagiarism, Research ethics

Module III (6L)

Effective technical writing, how to write report, Paper

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module IV (6L)

Nature of Intellectual Property: Patents, Design, Trade and Copyright, Process of Patenting and Development: technological research, innovation, patenting, and development. International Scenario: International cooperation on Intellectual property. Procedure for grants of patents, Patenting under PCT.

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical indication.

New developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge case studies, IPR and IITs.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

References:

- Stuart Melville and Wayne Goddard, “Research and methodology: An introduction for science & engineering students’”
- Wayne Goddard and Stuart Melville, “Research and methodology: An introduction”
- Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
- Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007
- Mayall, “Industrial Design”, McGraw Hill, 1992
- Niebel, “Product Design”, McGraw Hill, 1974
- Asimov, “Introduction to Design”, Prentice Hall, 1962
- Robert P. Merges, Peter S. Menell, Mark A Lemley, “Intellectual Property in New Technological Age”, 2016
- T. Ramappa, “Intellectual Property Rights Under WTO”, S Chand, 2008

First Year, Second Semester (M.Tech, ECE)

Course Title: ADVANCED DIGITAL COMMUNICATION TECHNIQUES					
Course Code : ECEN5201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

1. Students will learn about the transmission techniques, synchronization in digital communication.

2. They will know about the modulation schemes, OFDM etc.

3. The students will acquire knowledge about the CDMA in details.

4. The students will have clear idea about estimation and detection schemes. They will be able to design reliable channel codings.

5. They will understand the differences between coding schemes.

6. The students will be able to analyse the digital communication quality.

Module – I [9 L]

Review of random variables and random processes

Review of baseband digital signal transmission –PCM DM ADM ADPCM. Inter Symbol Interference (ISI)

Nyquist criteria for no ISI in band limited channel

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Parametric decoding: Sub-band coding APC LPC voice excited vocoder

Synchronization – Symbol and Frame synchronization

Equalizer: Linear equalization Decision feedback equalizer iterative equalizer and decoding

Module – II [9 L]

Digital Modulation:

Review of modulation schemes – BPSK DPSK QPSK M-ary PSK QASK MSK BFSK M-ary FSK –

principles transmitters receivers signal space presentation bandwidth efficiency

HOD, ECE Department
Heritage Institute of Technology
Kolkata

GMSK Orthogonal frequency division multiplexing (OFDM) – principle generation and detection

Bit error performance of bandpass signal – Narrow band noise model Error performance of BASK BPSK

BFSK MSK Comparison of bandwidth efficiency and error performance of modulation schemes

Module – III [9 L]

Multiplexing and multiple access : TDM/TDMA FDM/FDMA Space DMA ALOHA –slotted ALOHA and reservation ALOHA CSMA-CD CSMA- CA basic techniques and comparative performances

Spread spectrum modulation: Principle of DSS, processing gain jamming margin single tone interference probability of error

Principle of frequency hopped spread spectrum (FHSS) – slow frequency and fast frequency hopping

Principle of CDMA Multiple access interference (MAI) and limit of simultaneous users

Digital cellular CDMA system – forward and reverse link error rate performance

Module – IV [9 L]

Optimum Detection and Estimation:

Noise vector in signal space Bayes detection of received signal, optimum M-ary receiver design

Decision region and minimum error probability

Optimum detection of 16 QAM signal, MPSK signal orthogonal and bi orthogonal signal

Decision criterion: maximum likelihood Neyman Pearson and Minimax decision criterion

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Estimation: Linear estimation – simple mean Linear mean squared error Wiener filter

Non linear estimation: Bayes estimation MAP ML estimates

Introduction to source coding (Hofmann and Shanon).

Introduction to error control coding (Linear Block Code and Convolution).

References:

1. Digital Communications 4th edition J G Proakis MGH international Edition

2. Principle of Communication Systems Taub and Schilling 7th edition TMH

3. Digital Communications :Fundamentals and Applications 2nd edn 2008 Bernard Sklar and Pabitra Kumar Ray Pearson Education

4. Principle of Digital Communications Simon Haykin Wiley Student Edition

5. Digital Communications Zeimer and Tranter CRC Press

6. Analog and digital Communication, B.P. Lathi, Oxford University Press.

Course Title: ADVANCED DIGITAL SIGNAL PROCESSING(DSP) and APPLICATIONS					
Course Code : ECEN5202					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

1. Students will know about the different transforms applied in signal processing.

2. They will have knowledge about LTI systems, Digital filters.

3. The students will know about multi- rate processing, wavelet transforms.

4. They will solve problems on FFT and DFT.

5. The students will know about the comparison of filters.

6. They will be able to apply the knowledge of wavelets.

Prerequisite: The student must be conversant with frequency domain analysis of discrete time signals and systems. They will be familiar with the various kind of adaptive filter design technique. Multirate Signal Processing fundamentals and applications of Wavelet Transforms will be covered.

Module I: [8 L]

Frequency Domain Analysis of Discrete Time Domain Signals and Systems: 6L

The concept of frequency in continuous time and discrete time signals. Fourier series for discrete periodic signals, Fourier Transform of discrete aperiodic signals, Power spectral densities of discrete aperiodic signals, Relationship between Fourier Transform and Z-Transform. Properties of Fourier Transform in discrete time domain; Time reversal, convolution, correlation, Wiener-Khintchine theorem, frequency shifting, modulation, windowing theorem, differentiation in digital frequency domain.Symmetry property for various types of signals.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module II: [10 L]

Frequency Domain Characteristics of LTI Systems

Response to complex exponential signals, steady state and transient response to sinusoidal signals, steady state response to periodic signals, response to aperiodic signals. Relation between system function H (z) and frequency response function h(w). Input-output correlation function and spectra, correlation functions and power spectra for random input signals.

Invertibility of LTI systems, minimum/maximum/mixed phase systems, homomorphic systems and homomorphic deconvolution.DFT & FFT.Computation of DFT and it's properties, computation of DFT via FFT, chirp z-transform.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module III: [9 L]

Design of Digital Filters

Design of FIR filters, Effect of various windows, Effect of finite register length, statistical analysis, stability effect, frequency sampling, Optimization Algorithm.

Adaptive Filters design, Single input, multiple input, State-Space Kalman Filter, Extended Kalman Filter, Unscented Kalman Filter Sample-Adaptive Filters, Recursive Least Square (RLS) Adaptive Filters, The Steepest-Descent Method, LMS Filter.

Power Spectrum

Estimation of Power Spectrum and Correlation, Non-parametric and Parametric methods, Minimum Variation Estimation methods, Eigen Analysis algorithm, Power Spectrum analysis using DFT, Maximum Entropy Spectral Estimation, Model-Based

Power Spectral Estimation.

Module IV: [8 L]

Multirate Signal Processing

Sampling Rate Conversion; Decimation and Interpolation; Time and Frequency Domain Characterization; Filters in Sampling Rate Alteration Systems; Multi-rate Design of Decimator and Interpolator; Poly-phase Techniques; Poly-phase Down-sampler and Interpolator; Poly-phase Filter Design; Two-channel QMF Banks. Alias free FIR and IIR QMF Banks; Perfect Reconstruction

Two-channel FIR Filter Banks; M-Channel Filter Banks Design; Cosine-Modulated M-channel Filter Banks Design;Wavelet Transforms

Fourier Transform and its limitations, Short Time Fourier Transform, Continuous Wavelet Transform, Discretization of the Continuous Wavelet Transform, Multiresolution Approximations; Wavelet and Scaling Function Coefficients, Orthonormality of

Compactly Supported Wavelets, Bi-orthogonal Decomposition, Harr Wavelets, The Daubechies Wavelets Construction, Fast Wavelet Transform and Image Compression, Denoising using Wavelets, Perfect Reconstruction Filter bank design using Wavelets.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

References:

1. Discrete – Time Signal Processing by A.V. Oppenheim and R. W. Schafer, with J. R. Buck (Prentice- Hall, 1998)

2. Digital Signal Processing Using MATLAB by V. K. Ingle and J. G. Proakis (Books/Cole,2000)

3. Digital Signal Processing: A Computer Based Approach by S.K. Mitra (Second edition , McGraw-Hill, 2001)

4. Digital Signal Processing: Principles, Algorithms and Applications by J. G. Proakis and D. G. Manolakis.

5. Digital Filter Design and Analysis, Antino, TMH.

6. Digital Signal Processing- Rabiner and Gold, PHI.

Course Title: TELECOMMUNICATION SYSTEMS & ENGINEERING					
Course Code : ECEN5231					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

1. Students will know about the different telephone networks, ADSL etc.

2. They will have knowledge about digital telephone systems and local area networks- features and parameters.

3. The students will be aware of ISDN and its operation.

4. They will be able to calculate the efficiency of a tel network.

5. They will know about the various 802.11 standards and their applications.

6. They will know about ATM operation and ATM networks.

Module I: Telephone Network [12 L]

• Introductory terminology;

Grade of Service, QoS, Blocking Network, Lost call handling. Erlang and Poisson Traffic formulas one-way and both-way circuits.

• Local Networks – subscriber loop design, shape and size of a serving area, voice Frequency Repeaters, Tandem Routing, Dimensioning of Trunks

• Switching & Signaling for analog Telephone networks: Switching concepts – Cross-bar switching . Signaling concepts: Supervisory signaling – E & M signaling – In-band & out-of-band signaling

• Design of long distance links: Design essentials for LOS Microwave systems, Path analysis or Link Budget, Fading , Diversity and Hot stand-by operation, VSAT networks, concept of Last Mile

Broadband connectivity – ADSL & HDSL

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module II: Digital Telephone Systems [12 L]

• PCM – PCM line Codes – Regenerative repeaters – Signal to noise ratio for PCM signals – North American DS1 – the European E1 digital hierarchy – Filter – distortion – echo – cross talk – SONET and SDH – PCM Switching :'Time – space – Time Switch – 'Space – Time – Space' Switch – Digital Network Synchronization – Digital loss

Module III: Local Area Networks [6 L]

• LAN topologies – overview of IEEE / ANSI LAN protocols – WLANS – different 802.11standards

Module IV: ISDN [8 L]

• ISDN - background & goals of ISDN – protocols – structures – ISDN and OSI

• ATM and B-ISDN – User-Network interface (UNI) configuration and architecture – ATM cell structure – cell delineation algorithm – ATM layering & B-ISDN . Advantages of BISDN

HOD, ECE Department
Heritage Institute of Technology
Kolkata

References:

1. Wiley Series in Telecommunications and Signal Processing by Roger L. Freeman

2. Telecommunication System Engineering, By N. N. Deb.

3. Telecommunication Switching, Viswanathan.

4. Telecommunication, Fraser.

Course Title: IMAGE PROCESSING AND PATTERN RECOGNITION					
Course Code : ECEN5232					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

1. Students will know about the basics of image processing, spatial filtering etc.

2. They will have knowledge about techniques applied for pattern recognition.

3. The students will know about image clustering and face recognition.

4. They will be able to classify and predict.

5. The students will acquire knowledge about identifying objects correctly.

6. They will earn the potential to develop new applications.

Module I: [10 L]

Image Processing Basics: Image definition, a simple image formation model, basic concepts of image sampling and quantization, representing a digital image, concept of pixel/ pel, spatial and gray level resolution, some basic relationships between pixels : Neighbors of a pixel, Adjacency, Connectivity, Path, Connected component, Connected component labeling. Distance measures: the three essential properties, Euclidean, City-Block and Chess-Board distance, concept of image operations on a pixel basis.

Popular image processing methodologies: Spatial domain technique : contrast stretching, basic point processing, thresholding function, concept of mask/ sub image, mask processing/ filtering, gray-level slicing, bit-plane slicing.

Basics of spatial filtering : convolution mask/kernel, concept of sliding mask throughout the image-space, smoothing(averaging) filter/ low pass filter. Image segmentation by global and local gray level thresholding, region growing, region splitting and merging techniques. Morphological algorithms: thinning, thickening, skeletons.

Color image processing: Perception of color: color fundamentals. Two popular color models: RGB & HSI, concept of RGB & HSI space and their conceptual relationships, mathematical conversion from RGB to HSI space and vice versa.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module II: [10 L]

Pattern Recognition

Basics of pattern recognition: Concept of a pattern: feature, feature vectors and classifiers. Importance of pattern recognition. Basic concept of fuzzy pattern recognition, linearly separable and inseparable classes, classes with some overlapping regions, convex and non-convex paradigm in this aspect.

Clustering: Basic concept of cluster analysis. Similarity (Proximity) metrics (indices) and clustering criteria. Partitional clustering: Extraction of natural groups that are inherent in some data set by hard c-means (k-means), fuzzy cmeans.

Concept of getting stuck to a local optimum (in objective functional space) by k-means and fuzzy c-means due to their initiation/ starting point. Fuzzy cluster validity index: Xie-Beni index.

Classification and prediction: Definition of classification and prediction. Basic task of a classifier. Concept of training & testing data and overfitting. Bayes classification: Bayes' Theorem, Naïve Bayesian classification. Classification by Back propagation: Multilayer Perception (MLP) neural network and Back propagation algorithm.

Global optimization techniques: Genetic Algorithms (Gas): Cycle of genetic algorithms, selection (Roulette wheel and Tourment) crossover, mutation, evaluation of fitness function, incorporation of elitism in GAs. Multi-objective

optimization using GAs. Simulated Annealing (SA): Analogy with physical annealing process, concept of energy and mechanism of energy minimization using SA, Necessity of an uphill movement during the process. Hybridization with partitional clustering techniques.

Module III:[9 L]

Image clustering applications: Mechanism of extracting pixel-patterns from a gray-scale image in various ways: e.g. forming feature space (like a two column matrix) treating the gray-value of center-pixel (of a local window) as the first feature and averaged value over a square-shaped local window (3x3 or 5x5 or like that) as the second feature, construction of high-dimensional feature space: e.g. treating all the pixel-gray-values of a local window as features (i.e. for 3x3 window 9-dimensional feature space will result). Application of partitional clusterings in the above mentioned feature-space to recognize the objects in the concerned image.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module IV: [9 L]

Applications in multispectral and multitemporal remotely sensed imagery: Identification of different land cover types from multispectral remote image data using supervised/ unsupervised classification: Clustering by Histogram peak selection & and its limitation in this context (i.e. remote image analysis). Unsupervised Change Detection using

squared-error clustering methodologies: The algorithm, process, key challenges, error estimations like missed alarms, false alarms and overall error, need of ground truth.

Image mining: Need, Image search and retrieval. Bottleneck of Text based image mining/ retrieval, Visual feature based image mining: Content-based image retrieval (CBIR).

Image based face recognition: Basic technique for Eigen face generation & recognition.

References:

1. R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, Pearson Education Asia, 2004

2. S.K. Pal, A.Ghosh, and M.K. Kundu, *Soft Computing for Image Processing*, Physica

3. Verlag, (Springer), Heidelberg,1999.

4. R. O. Duda, P.E. Hart and D. G. Stork, *Pattern Classification*, John Wiley & Sons (Low Priced Edition).

5. Anil K. Jain and R.C.Dubes, *Algorithms for Clustering Data*, Prentice Hall.

6. S. Theodoridis and K. Koutroumbus, *Pattern Recognition*, Elsevier.

7. A. Ghosh, S. Dehuri, and S. Ghosh (editors). *Multi-Objective Evolutionary*

8. *Algorithms for Knowledge Discovery from Databases*. Springer, Berlin,

9. 2008.

10. Anil K. Jain, *Fundamentals of Digital Picture Processing*, Prentice Hall.

Course Title : COGNITIVE RADIOS AND NETWORKS					
Course Code : ECEN5241					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

The following outcomes (COs) are expected from the students after completion of the course –

1.An ability to apply knowledge of mathematics, science and engineering in the emerging areas of RF communication.

2.An ability to analyze a performance in a radio net.

3.An ability to learn and apply modular approach in design.

4.An ability to understand emerging research work in new areas of cognitive radios and spectrum hole sensing.

5.Development of a passion to pursue next generation wireless communication.

6.An power of analysis to apply correct technique in locating radios in networks.

Module I: [8 L]

INTRODUCTION TO SOFTWARE DEFINED RADIO

Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications. Differences between software enable radio and software defined radio. Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

Module II: [8 L]

COGNITIVE RADIO TECHNOLOGY

Introduction – Radio flexibility and capability – Aware – Adaptive – Comparison of Radio capabilities and Properties – Available Technologies – IEEE 802 Cognitive Radio related activities – Application, position awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module III: [10 L]

COGNITIVE RADIO DESIGN AND CHALLENGES

Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture. Design Challenges associated with CR – Hardware requirements – Hidden primary user problem – detecting spread spectrum primary users – sensing duration and frequency – security

Module IV: [8 L]

SPECTRUM SENSING

Spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design, applications of cognitive radios to optimize spectrum utilization, to reduce transmit power reduction and to improve data rate even in noisy conditions. Matched filter – waveform based sensing – cyclostationary based sensing – Energy detector based sensing – Radio Identifier – Cooperative sensing- other sensing methods.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

TOTAL: 34 PERIODS

<u>Reading:</u>

1. Joseph Mitola III, “Software Radio Architecture: Object-Oriented Approaches to wireless system Engineering”, John Wiley & Sons Ltd. 2000

2. Thomas W. Rondeau, Charles W. Bostain, “Artificial Intelligence in Wireless communication”, ARTECH HOUSE. 2009.

3. Bruce A. Fette, “Cognitive Radio Technology”, Elsevier, 2009.

4. Ian F. Akyildiz, Won- Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, “Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey” Elsevier Computer Networks, May 2006

5. Simon Haykin, “Cognitive Radio: Brain-Empowered Wireless Communication”, IEEE Journal on selected areas in communications, Feb 2005.

6. Markus Dilinger, Kambiz Madani, Nancy Alonistioti, “Software Defined Radio”, John Wiley, 2003

7. Huseyin Arslan,”Cognitive Radio, SDR and Adaptive System”, Springer, 2007.

8. Bruce A. Fette, “Cognitive Radio Technology”, Elsevier, 2009.

Course Title: MICROWAVE MEASUREMENT AND INSTRUMENTATION					
Course Code : ECEN5242					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

At the end of the course, the students will acquire the following.

1. Knowledge about the microwave measurement procedures

2. Ability to analyse instruments like spectrum analyzer, Vector Network analyzer etc.

3. Ability to measure microwave power.

4. Idea about techniques to measure power.

5. Capability to analyse problem in measurement procedure and improve.

6. Knowledge about special procedure like TDR.

MODULE I : [10 L]

Introduction to Radio Frequency and Microwave Measurement.

: Microwave Detectors and Sensors. Different types of microwave detectors, their functions and applications. Microwave sensors – working principles and applications

Microwave Power Measurement- Low Power Measurement- Bolometer technique. High Power Measurement – Calorimetric method

MODULE II : [10 L]

Microwave Attenuation Measurement

Microwave Frequency Measurement. Slotted Line technique. Wave meter method - Absorption and Transmission type wave meter

Microwave Impedance Measurement – Slotted Line technique to measure VSWR and unknown Load Impedance. Application of Smith chart in transmission line measurement

HOD, ECE Department
Heritage Institute of Technology
Kolkata

MODULE III : [9 L]

Microwave Cavity parameter measurement. – Cavity Q measurement by Slotted Line technique. Swept Frequency method Decrement methodMeasurement of Dielectric constant of a solid and liquid at microwave frequency by Waveguide method.

Cavity perturbation method

MODULE IV : [9 L]

Introduction to Microwave Instrumentation:

Spectrum Analyzer ; Block diagram of a spectrum analyzer – operational features of functional units and applications of Spectrum Analyzers.

Vector Network Analyzer (VNA) : Block diagram of VNA operational aspects of different functional units comprising VNA. Measurement of Scattering parameters and other applications.

Time Domain Reflectometer (TDR) : Block diagram of TDR and its working principle

Reflection coefficient measurement and interpretation of Time domain Reflected waveform.

Industrial applications of TDR.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

References:

1. G.H.Bryant- Principles of Microwave Measurements- Peter Peregrinus

Ltd.

2. T.S.Laverghetta- Hand book on Microwave Testing

3. S.F.Adam- Microwave Theory & Application- Prentice Hall, Inc

4. A.E. Bailey, Ed. Microwave Measurements- Peter Peregrinus Ltd

5. Annapurna Das and S K Das Microwave Engineering TMH Publications

6. HP Application Notes

Course Title :DESIGN OF COMMUNICATION EQUIPMENTS AND SYSTEMS					
Course Code : ECEN5243					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

The following outcomes (COs) are expected from the students after completion of the course –

1.An ability to apply knowledge in designing electronics for communication engineering.

2.An ability to analyze and interpret data.

3.An ability to learn and apply modelling based approach through the extensive use of simulator tools.

4.An ability to pursue research work in new areas of communication equipments and systems.

5.Design of complex PCBs.

6.Clear perception about testing of parameters.

Module I: [10 L]

Design Considerations of Communication equipments and systems:
Implementing Radio Link, Path profile, RF path loss calculations, Transmitter / Receiver parameters and their significance – SNR, SINAD, sensitivity, Hum and Noise, Quieting, Distortion, Rated RF power, RF power, Fade Margin.

Study and evaluation of Performance parameters for data communication like Bit and symbol error rates, Spectral Bandwidth calculations.

Module II: [10 L]

Design of various blocks of communication equipments such as PLL, Equalizer, Interleaver, Interference consideration in processor / controller enabled radios- desensitization problem, means to mitigate the problem – detailed study of clock speed & shape, PCB design.

Module III: [10 L]

PCB Design and EMI/EMC

PCB design practices for Analog and Mixed signal circuits- Ground loops, Precision circuits, supply isolation, shielding and guarding – different techniques. PCB design practices for High Speed Digital circuits, signal integrity and EMC. EMI/EMC testing standards and compliance.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module IV: [8 L]

Types of antenna – selection procedure for correct antenna, measurement of the network performance – different techniques.

Emulation of testing procedure in laboratory, test procedures for Receiver / Transmitter parameters with different standards like CEPT, EIA.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

<u>Reading:</u>

1. "High-speed Digital Design- A Handbook of Black Magic" – Howard Johnson, Martin Graham- Prentice Hall.

2. "EMC for Product Designers" – Tim Williams – Elsevier 2007.

3. "Digital Communication" – B. Sklar – Pearson Ed.

4. "Circuit Design for RF Transceiver" – D. Leenaerts, Johan van dar Tang, Cicero S. Vaucher – kluwer Academic Publishers, 2003

5. "Practical Radio Engineering & Telemetry for Industry" – David Bailey – Elsevier, ISBN 0750658037.

Course Title: Advanced Digital Signal Processing(DSP) and Applications Laboratory					
Course Code : ECEN5252					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course outcomes:

HOD, ECE Department
Heritage Institute of Technology
Kolkata

The students will acquire understanding of the following:

1.Basics of sampling, convolution etc, Z-transform

2. DFT and FFT and their applications

3.Filters – IIR and FIR

4.Digital filters, multirate signal procesing.

Simulation Laboratory using standard Simulator:

1. Convolution of two sequences using graphical methods and using commands- verification of the properties of convolution.
2. Z-transform of various sequences – verification of the properties of Z-transform.
3. Twiddle factors – verification of the properties.
4. DFTs / IDFTs using matrix multiplication and also using commands.
5. Circular convolution of two sequences using graphical methods and using commands, differentiation between linear and circular convolutions.
6. Verifications of the different algorithms associated with filtering of long data sequences and Overlap –add and Overlap-save methods.
7. Butterworth filter design with different set of parameters.
8. Chebyshev filter design with different set of parameters.
9. FIR filter design using rectangular, Hamming and Blackman windows.

Hardware Laboratory using Xilinx FPGA:

1. Writing of small programs in VHDL and downloading onto Xilinx FPGA.
2. Mapping of some DSP algorithms onto FPGA.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title: DESIGN AND SIMULATION LABORATORY					
Course Code : ECEN5253					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcome: Designing graphical user interfaced models of various communication systems/ subsystems with the help of suitable advanced software e.g. MATLAB/ OCTAVE/LABVIEW/ NS/ PUFF/ IE3D/ ANSOFT/ HFSS/ CST/ QUALNET/ MICROWAVE OFFICE etc. for detailed study of their operating principle and their performance vis-a-vis practical limitations like, channel bandwidth, noise, attenuation etc.

Suggested topics are

1. ADPCM – granular noise & quantization noise.

2. MPSK – signal bandwidth, PSD, distinguishability, scatter plot etc.

3. Digital filters – ripples in pass band & stop band, slope in transition band, poles & zeros etc.

4. Optimum filters for receiving base band random binary data – Pe vs. S/N.

5. Signal bandwidth and Pe vs. S/N in different modes of line coding.

6. Signal bandwidth and Pe vs. S/N in different modes of modulation.

7. Error rates in error control for different types of error control coding.

8. Throughput vs. input density in different MAC protocols.

9. DSSS – error rate due to different types of chip code.

10. Fading channel/ multipath transmission and Rake receiver.

11. Cellular architecture, WiFi, WiMAX using QUALNET.

12. OFDM using QUALNET.

13. Different routing algorithms & protocols.

14. Characterization of micro strip antenna.

15. Characterization of transmission lines.

16. Study of important parameters and practical considerations in microwave circuits.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title: DIGITAL VLSI IC DESIGN					
Course Code : VLSI5101					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

CO (Course Outcome):

1. Students will learn CMOS Circuit used in Digital VLSI Domain
2. Students will learn Physical Layout Design of CMOS Standard Cell
3. Students will learn Digital VLSI Design Methodology
4. Students will learn HDL coding
5. Students will learn EDA High Level and Logic Level Synthesis Algorithms
6. Students will learn EDA Physical Place and Route Automation Algorithms

Module I: VLSI Circuits & Physical Layout: [12L]

Unit1: MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Logical Effort, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop, Pseudo NMOS Logic, Dynamic gate, Domino and NORA Logic

Unit2: CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm, Layout Legging.

Module II: VLSI Design Methodology: [8L]

Unit1: Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node,

Unit2: Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX, VLSI Design Cycle, Y-Chart.

Module III: EDA Tools: High level Synthesis and HDL: [8L]

Unit1: High level Synthesis EDA Flow, Control and Data Flow Graph, Scheduling, Allocation, Binding, RTL

Unit2: Why HDL ? Frontend Design Flow using HDL (Behavioral, RTL and Gate Level), VHDL/Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed, FSM Example: Mealy Machine and Moore Machine.

Module IV: EDA Tools: Logical Synthesis and Physical Design Automation: [12L]

Unit1: Combinational Logic Optimization: BDD: Binary Decision Diagram, OBDD, ROBDD, Technology Mapping: Pattern DAG, Subject DAG, Sequential Logic Optimization

Unit2: Physical Layout Automation EDA Flow, Partitioning: KL Algorithm, Floor-planning cost function, Placement, Detailed Routing: Channel Routing, Horizontal Constraint Graph, Vertical Constraint Graph, Cyclic Constraint, Left-edge Algorithm, Global Routing: Steiner Tree, Maze Routing.

Text Book:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000
2. Algorithms for VLSI Physical Design Automation, Author: N. Sherwani, KLUWER ACADEMIC PUBLISHERS (3rd edition)

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Reference Book:

3. CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3^{rd} Edition), 2006
4. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011
5. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
6. VLSI Design and EDA TOOLS, Author: Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, SCITECH PUBLICATIONS (India) Pvt. Ltd., 2011
7. Algorithms for VLSI Design Automation, Author: Gerez, Wiley, 2011
8. A VHDL Primer, J. Bhasker, Prentice-Hall, 2013

Course Title: EMBEDDED SYSTEMS DESIGN					
Course Code : VLSI5102					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

CO (Course Outcome):

1. Students will learn Embedded System Design Methodology
2. Students will learn Embedded Processor Design
3. Students will learn 8051 Micro-controller
4. Students will learn basics of PIC & ARM Micro-controller
5. Students will learn Embedded Memory Architecture and Interface
6. Students will learn I/O Device configurations and Interfacing

Module I : Introduction to embedded systems: [8L]
Embedded systems overview with various type of examples in different domains such as in communication systems, robotics application and in control application, Design challenge – optimizing design metrics, embedded processor technology, Difference between embedded computer systems and general purpose computer Systems, Design methodology.

Module II: Embedded system processor design: [12L]
Custom single-purpose processors design: using finite state machine model and RTL model.
Standard single-purpose processors design: Timers, and watchdog timers, LCD controller.
Interfacing of Embedded Processors: Hardware protocol basics, interfacing with a general-purpose processor, RS232, I2C, CAN protocol.

Module III: [10L]
Introduction to 8051 microcontroller: 8051 architecture, pin configuration, I/O ports and Memory organization. Instruction set and basic assembly language programming. Interrupts, Timer/Counter and Serial Communication in 8051, Introduction to PIC & ARM micro-controllers.

Module IV: [10L]
Interfacing with Memory & I/O Devices:
Different types of embedded memory devices and interfacing: SRAM, DRAM, EEPROM, FLASH, CACHE memory. Different types of I/O devices and interfacing: Keypad, LCD, VGA. Square wave and pulse wave generation, LED, A/D converter and D/A Converter interfacing to 8051.

Text Book:
1. Embedded System Design: A Unified Hardware/Software Approach – 2nd Ed Frank Vahid and Tony Givargis

Reference Book:
2. Computers as Components: Principles of Embedded Computing System Design – 2nd Ed Wayne Wolf.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title : DSP FOR VLSI SYSTEM					
Course Code : VLSI5131					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

CO (Course Outcome):

1. Students will learn DSP Algorithm
2. Students will learn Signal and Data flow graph
3. Students will learn Pipelining and Parallel Processing
4. Students will learn Retiming Techniques
5. Students will learn SISO systems
6. Students will learn MIMO Systems

Module I: **DSP Algorithms: [14L]**
Typical DSP Algorithms, Adaptive Filters, Discrete Cosine Transform, Vector Quantization, Viterbi Algorithm, Decimator & Expander, Wavelet Transform, Filter Banks.

Module II: **Iteration Bound: [8L]**
Signal-flow graph, Data-flow graph, Dependence graph, Critical path, Loop & Iteration bounds, Computation of iteration bound .

Module III: **Pipelining and Retiming Techniques: [8L]**
Fine-grain pipelining of FIR filter, Low power aspects for pipelining and parallel processing, Cutset retiming, Clock period and Register minimizations.

Module IV: **Unfolding Algorithms: [10L]**
SISO and MIMO systems, properties of unfolding, sample period reduction, word and bit level parallel processing.

Text Book:

1. VLSI Digital Signal Processing Systems: Design and implementation
   Keshab K Parhi, Wiley India, 2008

Reference Book:

2. DSP Processor Fundamentals: Architectures and Features, Phil Lapsley, Jeff Bier, Amit Shoham, Edward Lee, Wiley – IEEE Press, Jan, 1997
3. Computer Architecture – A Quantitative Approach, John L Hennessy, David A. Patterson,, Elsevier, 2012.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title: VLSI IC FABRICATION					
Course Code : VLSI5132					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

CO (Course Outcome):

1. Students will learn Clean Room Concepts.
2. Students will learn individual fabrication steps.
3. Students will learn Pattern Transfer to Si from Mask using Lithography
4. Students will learn Semiconductor Doping Techniques
5. Students will learn planner MOSFET fabrication Process
6. Students will learn SOI fabrication Technology

Module I: Clean Room Technology and Oxidation [12L]

Unit1: Clean room concept- growth of single crystal from melt, surface contamination, cleaning and etching by solvent method and RCA clean.

Unit2: Growth mechanism and kinetics of oxidation, oxidation techniques and systems, oxide properties, oxide induced defects, characterization of oxide films use of thermal oxide and CVD oxide, growth and properties of dry and wet oxides, dopant redistribution, oxide quality. Etching Technology, Different kind of Interconnects, Concept of VIA.

Module II: Diffusion and ion implantation [10L]

Unit1: Diffusion: Fick's equation, atomic diffusion mechanisms, measurement techniques, diffusion in polysilicon and silicon dioxide diffusion systems.

Unit2: Ion Implantation: Range theory, equipments, annealing, shallow junction, high energy implantation.

Module III: Lithography, Deposition and Metallization [12L]:

Unit1: Lithography: Optical lithography, some advanced lithographic techniques

Unit2: Physical vapor deposition: APCVD, Plasma CVD, MOCVD

Unit3: Metallization: different types of metallization, uses and desired properties

Module IV: Process Integration [6L]:

MOSFET technology and MESFET Technology, IC manufacturing, future trends and challenges, SOI fabrication,

Text Book:

1. Semiconductor Devices Physics and Technology, Author: Sze, S.M.; Notes: Wiley, 1985
2. VLSI Technology 2ND Edition, Author: Sze, S.M.; MCGRAW HILL COMPANIES

Reference Book:

3. An Introduction to Semiconductor Microtechnology, Author: Morgan, D.V., and Board, K
4. The National Technology Roadmap for Semiconductors , Notes: Semiconductors Industry Association, SIA, 1994
5. Electrical and Electronic Engineering Series VLSI Technology, Author: Sze, S.M. Notes: Mcgraw-Hill International Editions

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title : CAD OF DIGITAL SYSTEM					
Course Code : VLSI5141					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

CO (Course Outcome):

1. Students will learn graph theory and data structures needed for CAD of VLSI
2. Students will learn basic algorithms needed for CAD of VLSI
3. Students will learn Physical Design Optimization on Partitioning and Floorplan
4. Students will learn Physical Sedign on Place and Route
5. Students will learn High Level and Logic Level Synthesis
6. Students will learn Verilog Modeling

Module I [10L]: VLSI design automation tools – Data structures and basic algorithms, graph theory and computational complexity, tractable and intractable problems.

Module II [10L]: General purpose methods for combinational optimization – partitioning, floor planning and pin assignment, placement, routing.

Module III [10L]: Simulation – logic synthesis, verification, high level Synthesis

Module IV [10L]: MCMS-VHDL-Verilog-implementation of simple circuits using VHDL

Text Book:

1. N.A. Sherwani, “Algorithms for VLSI Physical Design Automation”.

Reference Book:

2. S.H. Gerez, “Algorithms for VLSI Design Automation.

HOD, ECE Department
Heritage Institute of Technology
Kolklata

Course Title: MODELLING OF VLSI DEVICE					
Course Code : VLSI5142					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

CO (Course Outcome):

1. Students will learn BJT Modeling
2. Students will learn MOSFET Operation
3. Students will learn source of various MOSFET Capacitor Components
4. Students will learn SCE (Short Channel Effect) in MOS Devices
5. Students will learn MOS Scaling concepts on Future Technologies
6. Students will learn Industry Standard Compact Modeling

Module I: Semiconductor Physics, p-n junction and BJT [8L]

Semiconductors , Conduction, Contact Potentials, P-N Junction, Modifying the simple diode theory for describing bipolar transistor, Effect of emitter and base series resistances, Effect of base-collector voltage on collector current, Bipolar device models for Circuit and Time-dependent analyses.

Module II: MOS Capacitors and MOSFETs [12L]

Band diagrams for accumulation, depletion and inversion, threshold voltage, weak, moderate and strong inversions, Pao-Sah drain-current model, Source of MOS Capacitance, Transient Response, Capacitance-Voltage curves.

Module III: Scaled MOS Transistors [12L]

Concept of scaling (field, voltage and generalized scaling), ITRS specifications, two-dimensional field patterns and Poisson's equation, charge sharing and barrier lowering, carrier mobility degradation, channel length modulation, velocity saturation, hot carrier effects (gate leakage, impact ionization)

Module IV: Compact Models [8L]

Definitions and types of compact models: physical, empirical and look-up table based models, threshold voltage-based, surface potential-based and charge-based compact models, Commercial compact models.

Text Book:

1. Fundamentals of Modern VLSI Devices by Yuan Taur & Tak H. Ning (Cambridge)

Reference Book:

2. The MOS Transistor (second edition) Yannis Ts ividi s (Oxford)
3. Compact MOSFET Models for VLSI Design by A.B. Bhattacharyya, John Wiley & Sons Pte. Ltd., IEEE Press, 2009.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title: Digital VLSI IC Design Lab					
Course Code : VLSI 5151					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

CO (Course Outcome):

1. Students will learn Cadence Virtuoso
2. Students will learn Schematic Entry of CMOS gates
3. Students will learn Pre layout simulation using Spectra
4. Students will learn Layout Entry of CMOS gates using Nano Technology with key focus on Standard Cells
5. Students will learn Layout Verification Techniques like DRC, LVS, Post Layout Extraction using Assura
6. Students will learn Post layout simulation using Spectra

List of Experiments:

Sub Micron and Deep Sub Micron Technology based Experiments:

1) Introduction to **Cadence Virtuoso & Assura Tools**
    a. Transient, DC, Parametric analysis of CMOS Inverter
    b. Implementation of Various Logic gates using Advanced CMOS technology
    c. Layout design and Verification Using Cadence: Std Cell Layout
    d. Parasitic Extraction, Back-annotation and Post Layout Timing Analysis Using Cadence
2) Introduction to **TCAD Synopsys** Device and Process Simulator: Nano Technology

HOD, ECE Department
Heritage Institute of Technology
Kolklata

Course Title: Embedded Systems Design Lab					
Course Code : VLSI 5152					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

CO (Course Outcome):

1. Students will learn Xilinx Vivado Simulator
2. Students will learn VHDL coding and Simulation/Verification
3. Students will learn Finite State Machine coding using HDL
4. Students will learn Test Bench HDL coding for RTL Verification
5. Students will learn FPGA synthesis, Place & Route and Hardware Programming
6. Students will learn ARM Cortex based Software/Hardware

List of Experiments:

1. Introduction to **XILINX-Vivado Simulator, VHDL Coding and Test Bench** Simulation
    a. Logic Design and Verification of a 15 bit Ripple-Carry Adder
    b. Logic Design and Verification of a universal shift register
    c. Logic Design and Verification of a Finite State Moore Machine
    d. Logic Design and Verification of a Finite State Mealy Machine
    e. Design of hand shake protocol to establish Communication between Master and Slave
2. **FPGA Programming Flow** using XILINX Kits: Implementing and verifying many of above experiments in FPGA hardware Kits.
3. **Embedded System Kits**: ARM Cortex M3 Evaluation Board and ARM Cortex based Microcontroller Development Software.
4. **DSP** C6713 Evaluation Kits

HOD, ECE Department
Heritage Institute of Technology
Kolkata

M.Tech, VLSI, 1st Year 2nd Semester:

Course Title: ANALOG VLSI IC DESIGN					
Course Code : VLSI5201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes (COs):

The students would be able to:

1. Understand and analyze MOS-based analog VLSI sub-circuits, relevant small-signal equivalent circuit models and design them *eg.* current mirrors,
2. Design and analyze MOS circuits of practical importance *eg.*, common-source amplifiers and differential amplifiers.
3. Understand the basic concepts in RF design and the geometry, models of passive devices used in the RFIC.
4. Understand the principle of operation, characterization of the data converter circuits and design them.
5. Understand and analyze the different topologies of switched-capacitor circuits and apply the concept for the analysis of circuits of practical applications.
6. Understand the principle of operation of the oscillator circuit and apply the concept for the analysis of circuits of practical applications.

Module I: Analog Sub-Circuits & Circuits using MOSFET : [16L]

Unit1(6L): Analog sub-circuits : Principle of operation, Small-signal analysis of MOS switch, resistors, current source, sink, current mirror, bandgap reference circuit.
Unit2 (6L): CMOS Amplifiers : Basic concepts, performance parameters, Single-stage amplifiers : different topologies of inverting type common-source amplifiers, common-gate, common-drain configuration; Differential amplifiers with passive and active load : Transfer characteristics curves, Common mode, differential mode, CMRR, small-signal analysis of relevant amplifier circuits ;
Unit 3 (4L): CMOS Operational Amplifiers & Comparators : Basic concepts, characterization & classification of op-amps, basic concept of boundary conditions & requirements for the design of op-amps, basic concept of necessity of compensation and Miller compensation technique; Comparators : Characterization, basic concept of Two-Stage open-loop comparator; Discrete-time Comparator : Switched capacitor comparators.

Module II: RFIC Fundamentals: [8L]

Unit1: Basic concepts in RF Design : General considerations : units in RF design, time variance, nonlinearity; Effects of nonlinearity : harmonic distortion, gain compression, cross modulation, inter-modulation, cascaded nonlinear stages, AM/PM conversion
Unit2: Passive Devices : General considerations, Inductors : Basic structure, geometries, parasitic capacitances, loss mechanisms, inductor modeling, transmission lines, varactors, constant capacitors : MOS capacitors, metal-plate capacitors.

Module III: Data Converter Fundamentals and Architecture [8L]

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Unit 1 : D/A Converters : Introduction & characterization, Architecture : Parallel D/A converters, Serial D/A converters

Unit 2 : A/D Converters : Introduction & characterization, S/H circuit, Architecture : Serial A/D converters, Medium-speed A/D converters, High-speed A/D converters : Parallel or Flash ADC, Oversampling converters : performance limitations and design considerations.

Module IV: Special Circuits: [8L]

Unit1: Switched-capacitor circuits : general considerations, resistor emulation using different topologies, accuracy issues, switched capacitor integrators, filters.

Unit2: Oscillators : Ring oscillator, Voltage Controlled Oscillator, Phase Locked Loop.

Text Book:

1. Design of Analog CMOS Integrated Circuit, Behzad Razavi, Mc, Graw Hill .
2. CMOS Analog Circuit Design (second edition), Phillip E. Allen and Douglas R. Holberg (Oxford)
3. RF Microelectronics, Behzad Razavi, Prentice Hall

References:

4. Microelectronic Circuits, A.S. Sedra & K.C.Smith, Oxford International student edition.
5. Analog Design for CMOS VLSI Systems - Franco Maloberti, Kluwer Academic Publishers

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title: VLSI DESIGN, TESTING AND VERIFICATION					
Course Code : VLSI5202					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

CO (Course Outcome):

1. Students will learn embedded Memory Design in VLSI Chip
2. Students will learn VLSI Interconnect Design
3. Students will learn Industry Standard STA (Static Timing Analysis) Method
4. Students will learn Set-up and hold Checks for Timing Verification
5. Students will learn process variation and Clock skew concepts
6. Students will learn Si Testing/Debug Methods

Module I: VLSI Memory Design: [12L]
Types of Memory, Memory Organization, Memory Folding Criteria, Memory Cell Design Method for Write and Read Operation, Critical Path Analysis & Memory Access Time, DRAM 4T, 3T, 1T Cell Design Method, SRAM 8T, 6T Cell Design Method, Sense Amplifier Operation, Multiport Register File Design Challenges, Mask ROM, ROM Programming Techniques, Flash ROM

Module II: VLSI Interconnect Design: [6L]
Component of Interconnect, Interconnect Cross Section, Wire material, Interconnect Modelling, Interconnect Design Issues and WirePlan: Capacitance, Delay, Lumped Model vs Distributed Model, RC Scaling, Repeater, Interconnect Power, Interconnect Noise: Coupling, Cross Talk

Module III: VLSI Verification Flows and Static Timing Analysis: [12L]
Unit1: Logic Verification, Circuit Verification, Layout Verification (DRC, LVS), pre-layout simulation, parasitic Extraction and Back-annotation, post layout verification,
Unit2: Timing checks (set-up, hold), process variation study with PVT analysis, Library Cell characterization, Static Timing Analysis: Types of Path for Timing Analysis, Launch path, Capture Path, Longest Path, Shortest Path, Critical Path, Clock Skew

Module IV: Si-Testing: [10L]
Why Testing, Challenge of Si-Testing, Manufacturing Defects, Die (Inter and Intra) Variation, Yield, DPM, Combinational Circuit Testing: Logical Fault Modelling: Stuck at Faults (D-Algorithm), Bridging Fault, Transistor Stuck open/Stuck Short, ATPG, Path Delay Fault, Sequential Circuit Testing: DFT, Scan Design, SFF, LSSD-SSF, BIST

Text Book:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000
2. VLSI Test Principles and Architectures, Design for Testability, Author: Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, The Morgan Kaufmann series in Systems on Silicon. 2006 Elsevier

Reference Book:

3. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011
4. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title: MEMORY TECHNOLOGIES					
Course Code : VLSI5231					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

CO (Course Outcome):

1. Students will learn SRAM Bit-cell Design
2. Students will learn SRAM architecture and periphery Circuits
3. Students will learn DRAM Bit cell Design
4. Students will learn DRAM architecture, periphery Circuits and Controller
5. Students will learn various ROM Design
6. Students will learn Future Memory Technologies like MRAM, FRAM

Module I: SRAM: [10L]
Random Access Memory Technologies: Static Random Access Memories (SRAMs), SRAM Cell Structures, MOS SRAM Architecture, MOS SRAM Cell and Peripheral Circuit, Bipolar SRAM, Advanced SRAM Architectures, Application Specific SRAMs.

Module II: DRAM: [10L]
MOS DRAM Cell, BiCMOS DRAM, Error Failures in DRAM, Advanced DRAM Design and Architecture, Application Specific DRAMs, DRAM Memory controllers.

Module III: Non-Volatile Memories: [10L]
Masked ROMs, PROMs, Bipolar & CMOS PROM, EEPROMs, Floating Gate EPROM Cell, OTP EPROM, EEPROMs, Non-volatile SRAM, Flash Memories.

Module IV: Advanced Memory Technologies: [10L]
Ferroelectric Random Access Memories (FRAMs), Gallium Arsenide (GaAs) FRAMs, Analog Memories, Magneto Resistive Random Access Memories (MRAMs), Experimental Memory Devices.

Text Book:

1. Ashok K Sharma, “Advanced Semiconductor Memories: Architectures, Designs and Applications”, Wiley Interscience

Reference Book:

1. Kiyoo Itoh, “VLSI memory chip design”, Springer International Edition
2. Ashok K Sharma,” Semiconductor Memories: Technology, Testing and Reliability , PHI

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title: LOW POWER VLSI DESIGN					
Course Code : VLSI5232					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

CO (Course Outcome):

1. Students will learn source of CMOS Dynamic Power Dissipation
2. Students will learn CMOS Dynamic Power Reduction Techniques
3. Students will learn source of CMOS Standby (leakage) Power Dissipation & Reduction Techniques
4. Students will learn Short Circuit Power Reduction Techniques
5. Students will learn Embedded Memory Power Reduction Techniques
6. Students will learn System and Architecture level Power Reduction Techniques

Module I: Dynamic Power Reduction: [12L]

Unit1: Introduction: Why Low Power ? Definition of dynamic power, Transition probability, Signal probability, Transition probability of basic gates, Glitch power, source of switching capacitance

Unit2: Dynamic Power reduction with Vdd, Delay vs Power Trade-off, Dual Vdd, Dynamic Voltage Scaling (DVS), Dynamic Power Management, Capacitance Scaling, Transistor sizing, Transition probability reduction by clock gating, Logic restructuring, Input Reordering, Glitch reduction

Module II: Standby Power Reduction: [12L]

Unit1: Leakage power definition, Gate Leakage, Channel Leakage, Junction Leakage. Channel leakage issue with Threshold Scaling, Leakage vs Dynamic power

Unit2: Technology Solution of Gate Leakage reduction: High-K, FinFET, Channel leakage reduction techniques: Multiple Threshold Voltage, Long Channel Transistor, Device Downsizing, Stacking, Power Gating, Dual Vdd, Dynamic Body-Biasing, Technology Solution: FinFET

Module III: Short Circuit Power Reduction: [6L]

Definition, Dependency on Load Capacitance, Various reduction techniques

Module IV: Power **Reduction at Various Design Phase: [10L]**

System level, Algorithm level, Architecture Level (Parallel vs Pipeline), Gate level, transistor level, Power Analysis Tool, Low Power Memory Circuit Example on DRAM, SRAM, ROM, Power issue with Dynamic Gates: Floating node and Keeper Solution.

Text Book:

3. Practical Low Power Digital VLSI Design, Author: Gary Yeap, KLUWER ACADEMIC PUBLISHERS, 2010

Reference Book:

4. Low Power CMOS VLSI Circuit Design, Author: Kuashik Roy and Sharat Prasad, John Wiley & Sons, Inc. 2009

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title: ADVANCED VLSI PROCESSOR					
Course Code : VLSI5241					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

CO (Course Outcome):

1. Students will learn basic structure of instruction set architecture (ISA)
2. Students will learn CISC and RISC Architecture
3. Students will learn sample DSP Processor Architecture
4. Students will learn Accelerator
5. Students will learn Multi-Threaded Processor
6. Students will learn use of Microprocessor cores in SOC Design

Module I: Fundamentals: [8L]
Architecture organization, basic structure of instruction set architecture (ISA arch) and Flynn's taxonomy. Comparison of Von-Neumann and Harvard architecture, Microcoded and hardwired control architecture, scalar and Vector processors architecture, CISC and RISC architecture. Basic of pipelining, pipeline hazards and solutions

Module II: The DSP and Its Impact on Technology: [12L]
Parallel computation using superscalar architecture, description of the very long Instruction word architecture (VLIW arch) , detail description of TI TMS320C5x DSP processor architecture.

Module III: Accelerator :[10L]
Need for accelerators, Accelerators and different types of parallelism, Processor architectures and different approaches to acceleration. General-Purpose Embedded Processor Cores: The ARM.

Module IV: Multiprocessor and multithreaded processor [10L]
Utilization of course-grain parallelism, chip-multiprocessors, multithreaded processors, SMT processor, A benefits analysis of processor customization, Using microprocessor cores in SOC design, Benefiting from microprocessor extensibility, how microprocessor use differs between SOC and board-level design

Text Book:
1. Computer Architecture: Pipelined and Parallel Processor Design – 2nd Ed Michael J. Flynn

Reference Book:
2. Digital Signal Processors: Architecture, Programming and Applications - B. Venkataramani, M. Bhaskar
3. ARM System-on-Chip Architecture – 2nd Ed Steve Furber
4. Computer System Design: System-on-Chip – 1st. Ed Michael J. Flyn, Wayne Luk

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title: ADVANCED NANO DEVICES					
Course Code : VLSI5242					
Contact Hours per week		T	P	Total	Credit Points
	3	0	0	3	3

CO (Course Outcome):

1. Students will learn various leakage phenomena in advanced MOS
2. Students will learn High K Plus Metal Gate Technology for advanced Process Nodes
3. Students will learn SOI MOS device
4. Students will learn FinFET Devices like DGMOS, Tri-gate
5. Students will learn Hetero-Structures
6. Students will learn CNT, Graphene Device

Module I: Leakage Current Mechanisms and Reduction (6+6=12L)

Unit 1: Sub-threshold leakage, band-to-band leakage, gate-oxide tunneling, gate-induced-drain leakage etc.
Unit 2: High-K gate dielectric and Metal-gate technology: Concept of EOT, leakage current control, use of various high-K oxides, work function engineering, Fermi-level pinning.

Module II: SOI MOSFETs [6L]

Partially-depleted SOI, Fully-depleted SOI, Advantages and disadvantages of SOI structure.

Module III: Multigate Structures [12L]

DG-MOSFETs, TRI Gate MOSFETs, FinFETs, Surround gate MOSFETs, Omega Gate MOSFETs, Volume inversion, Random Dopant Fluctuation, Concept of undoped body, Underlap device structure, Symmetry and asymmetry MOSFET structure.

Module IV: Hetero Structures and Quantum Well devices [10L]

Quantization and low-dimensional electron gas, band alignment in Si/SiGe hetero-structures, HEMTs, Carbon Nano-tube, Graphene device.

Text Book:

1. The MOS Transistor (second edition) Yannis Tsividis (Oxford)

Reference Book:

2. Fundamentals of Modern VLSI Devices by Yuan Taur & Tak H. Ning (Cambridge)
3. FinFETs and Other Multi-Gate Transistors by J.P. Colinge, Springer, 2008.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title: Analog VLSI IC Design Lab					
Course Code : VLSI 5251					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcomes (COs):

The students would be able to:

1. Understand the basic principle of operation of NMOS and PMOS
2. Analyze and design analog VLSI sub-circuits and amplifier circuits
3. Design layout and verify for analog VLSI sub-circuits and circuits
4. Realize and analyze some special circuits namely data converters, practical switched-capacitor circuits.

Sub-Micron and Deep Sub-Micron Technology based Experiments:

List of Experiments:

1. Familiarization with Cadence Virtuoso and Assura tool
2. Study of Transfer and Drain Characteristics of NMOS and PMOS
3. Study of MOS as a Capacitor, diode, and active resistor in implementing voltage divider circuit
4. Study of Current Mirror and Cascode Current Mirror Circuits
5. Layout design and verification of current mirror circuit using Common Centroid technique.
6. Circuit analysis of Single Stage Amplifiers
7. Layout design and verification of single-stage amplifier
8. Design and analysis of Differential Amplifier
9. Layout Design of Differential Amplifier
10. Introduction to Texas Instruments Analog Systems Laboratory Starter Kits (ASLK) and realization of data converter circuits.
11. Design and analysis of a switched-capacitor filter.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Title: VLSI Design, Testing and Verification Lab					
Course Code : VLSI5252					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

CO (Course Outcome):

1. Students will learn Critical Path Modeling and Analysis
2. Students will learn Sizing in Digital Design
3. Students will learn CMOS Design of Combinational Circuits and Modules
4. Students will learn CMOS Design of Sequential Circuit, Setup and Hold Check
5. Students will learn Layout of a system, DRC, LVS, Extraction using Cadence Virtuoso/Assura
6. Students will learn Back-annotation and Post Layout Timing Analysis using Spectra

List of Experiments:

Sub Micron and Deep Sub Micron Technology based Experiments:

1) Combinational Circuit Example (**Cadence Virtuoso and Assura Tools**)
    a. Circuit Design,
    b. Critical Path Timing Analysis,
    c. Layout Design and Verification,
    d. Parasitic Extraction, Back-annotation and Post Layout Timing Analysis
2) Sequential Circuit Example (**Cadence Virtuoso and Assura Tools**)
    a. Circuit Design,
    b. Setup and Hold Analysis,
    c. Layout Design and Verification,
    d. Parasitic Extraction, Back-annotation and Post Layout Timing Analysis
3) **Cadence Semi Custom Design** Flow
    a. **Incisive Logic Simulation**: Verilog Coding and Test Bench Verification
    b. **Encounter RTL Compiler**: Logic Synthesis
    c. **Encounter Physical Design Implementation**: Floor-planning, Power-planning, Placement, CTS, Routing, Static Timing Analysis
    d. **ASIC views -** .lib, .lef, .gds, .sdf
    e. **Std. cells-** Design, layout, characterization
    f. **Logical Equivalence checking**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

M. Tech. Detailed Syllabus - Semester I

Course Name : Advanced Data Structure					
Course Code: CSEN5101					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of the course the students undergoing this course are able to:

1. Remember definitions and notations of basic terminologies used in data structures.
2. Learn and understand abstract data types and its significance; differentiate between linear and non-linear data structures for solving real world problems.
3. Understand and apply some of the special trees, Tries data structure and various Hashing Techniques
4. Design modular algorithms on linear and non linear data structures for solving engineering problems efficiently.
5. Understand and analyze the basic principles of different string matching algorithms and identify their advantages and disadvantages.
6. Evaluate the performance of different data structures with respect to various applications.

Module I: Review of Fundamental Concepts (9L)

Introduction: Arrays, lists, stacks, queues, heaps, priority queues, Dictionary operations, Abstract Data Types (ADTs).

Hashing: Hash tables, hash functions, collision resolution by chaining, Collision resolution by open addressing, linear and quadratic probing, Double hashing, extensions and recent advances.

Module II: Binary Trees (9L)

BasicFeatures and Procedures: Binary tree traversal methods, total path length in binary trees, Binary search trees, insertion and deletion of keys, Worst-case and average case times for search, insertion and deletion.

Module III: Other Data Structures for Storage and Search (9L)

B-Trees: Broad shallow tree structures for secondary storage, Insertion and deletion of keys in B-trees, insertion and search times.

Skip Lists: Need for randomized methods, search and insertion in skip lists, Probabilistic analysis, deterministic skip lists.

Special Types of Binary Trees: AVL trees, Red-Black trees, 2-3 trees, other types.

Module IV: Additional Topics (9L)

Computational Geometry: Introductory concepts, one and two dimensional range searching Priority search trees, priority range trees, quadtrees, k-D trees.

Pattern Matching in Strings: Brute force methods, Boyer-Moore algorithm, Knuth-Morris-Pratt algorithm, Tries, Huffman codes, extensions.

References:

1. T H Cormen, C E Leiserson, R L Rivest, C Stein, Introduction to Algorithms (3rd Ed., 2009), The MIT Press.
2. D E Knuth, The Art of Computer Programming (latest editions), Volume 1 (Fundamental Algorithms) and Volume 3 (Sorting and Searching), Addison Wesley.

Course Name : Research Methodology and IPR					
Course Code: CSEN5102					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	**0**	**0**	**2**	**2**

Course Outcomes:
On completion of the course the students undergoing this course are able to:
1. Understand some basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Prepare a project proposal (to undertake a project)
5. Organize and conduct research (advanced project) in a more appropriate manner
6. Write a research report and thesis

Module 1: Introduction:
Definition of Research. Different types of research. Different types of methods for research. Definition of Research Methodology. Research Methods vs. Methodology. Experimental Computer Science versus Theoretical Computer Science.

Module 2:
Part I: Literature Survey and Problem Formulation:
Definition of Literature. Selection of research topic. Survey Procedures. Problem identification. Criteria for prioritizing problems for research. Problem Formulation.
(Discuss in class Web Search: Introduction to Internet. Use of Internet and www. Using of search engines and advanced search tools.)
Part II: Data Collection and Simulation

Module 3: Data Analysis
Analysis tools: Review of Basic Statistical Measures (mean, median, mode, quartile, percentile, variance, covariance, correlation, regression), Probability Distributions (Binomial, Poisson, Uniform, Exponential, Normal), Central Limit Theorem, ANOVA, Latin Square Design, Sampling (Chi-square Distribution, F- Distribution), Test of Hypothesis.

Module 4: Reporting
Technical report writing, Technical paper writing, Plagiarism, Learning Latex
Presentation tool: Introduction to presentation tool, features and functions, creating presentations, customising presentation. [Tools used: Microsoft PowerPoint, Open Office or any other tool]
Spreadsheet tool: Introduction to spread-sheet applications, features and functions, using formulae and functions, data storing, features for statistical data analysis, generating charts/graphs and other features. Functions and Macro [Tools: Microsoft Excel, Open office and similar or other advanced tools]
Patent writing, Patent filing, IPR

References:

1. Research Methodology 2nd Edition, R. Panneerselvam, PHI Publishers.
2. Research Methodology Methods and Techniques, 2nd revised edition, C. R. Kothari, New Age International Publishers.
3. A Guide to LATEX: Document Preparation for Beginners and Advanced Users, 3rd Edition, Helmut Kopka, Patrick W. Daly, Addison-Wesley, 1999.
4. Intellectual Property Rights, Neeraj Pandey, Khushdeep Dharni, PHI Learning Pvt. Ltd., 2014.
5. Microsoft Office Word 2013: A Skills Approach, Inc. Triad Interactive, McGraw-Hill Education, 2014.

CSEN5131 – CSEN5140	Professional Elective I
CSEN5131	Machine Learning
CSEN5132	Advanced Wireless and Mobile Networks
CSEN5133	Introduction to Intelligent Systems
CSEN5134	GPU Computing
CSEN5135	Image Processing

Course Name : Machine Learning					
Course Code: CSEN5131					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of the course the student should be able to:

1. Learn and understand various machine learning algorithms;
2. Understand complexity of Machine Learning algorithms and their limitations;
3. Compare and contrast various machine learning techniques and to get an insight of when to apply a particular machine learning approach;
4. Mathematically analyze various machine learning approaches and paradigms;
5. Apply common Machine Learning algorithms in practice and implementing their own;
6. Perform experiments in Machine Learning using real-world data

Module 1: Supervised Learning (Regression/Classification) (9L)

- Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes
- Linear models: Linear Regression, Logistic Regression, Generalized Linear Models
- Artificial Neural Networks: Neural Network Model, Back propagation algorithm; Introduction to Radial Basis Function, Recurrent Neural Network, Convolution Neural Network
- Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Module 2: Unsupervised Learning (9L)

- Clustering: K-means/Kernel K-means, DBScan
- Dimensionality Reduction: PCA and kernel PCA
- Matrix Factorization and Matrix Completion

Module 3: (9L)

- Components of learning; Error and Noise; Training vs Testing: From Training to Testing,
- Dichotomies, Growth Function, Break Points, VC Dimension
- Bias-Variance Tradeoff: Bias and Variance, Learning Curves

Module 4: (9L)

- Support Vector Machines, Nonlinearity and Kernel Methods
- Overfitting: What is overfitting? Dealing with overfitting
- Regularization: informal and formal, Weight decay, Choosing a regularizer
- Deep Learning

References:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
4. Tom Mitchell, Machine Learning, First Edition, McGraw-Hill, 1997.
5. Simon Haykin, Neural Networks and Learning Machines, Third Edition, PHI Learning, 2009.
6. Amit Konar, Computational Intelligence Principles, Techniques and Applications, Springer, 2012.
7. Y. S. Abu-Mostafa, M. Magdon-Ismail, H. T. Lin, Learning from Data - A short Course, AMLbook.com.
8. J. Han and M. Kamber, Data Mining Concepts and Techniques, 3rd, Edition, Morgan Kaufmann Publishers, July 2011.

Course Name : Advanced Wireless and Mobile Networks					
Course Code: CSEN5132					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of the course the student should be able to:

1. Learn the wireless/mobile market and the future needs and challenges.
2. Understand the state-of-the-art in network protocols, architectures and applications.
3. Understand the foundation of understanding and working for future generation of wireless systems
4. Understand the concept of Continuous Time Markov Chain (CTMC)
5. Learn to analyze the quality of a network.
6. Acquire the ability to design new protocols for wireless networks and analyse them.

MODULE 1 (9L)

- INTRODUCTION: Wireless Networking Trends, Key Wireless Physical Layer Concepts, Multiple Access Technologies -CDMA, FDMA, TDMA, Spread Spectrum technologies,
- Frequency reuse, Challenges in Mobile Computing: Resource poorness, Bandwidth, energy etc.
- RADIO PROPAGATION AND MODELLING: Modeling of radio propagation channels including path-loss models, Lognormal shadowing, fading and multipath.
- WIRELESS CELLULAR NETWORKS: 1G and 2G, 2.5G, 3G, Cellular architecture, Frequency reuse, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, Spread spectrum Technologies.
- TOOLS TO EVALUATE NETWORK PERFORMANCE: Introduction to Markov Chain, Channel assignment strategies, evaluation of channel assignment strategies using Continuous Time Markov Chain.

MODULE 2 (9L)

- ADVANCED WIRELESS CELLULAR NETWORKS: OFDM, 4G networks, WiMAX (Physical layer, Media access control, Mobility and Networking), LTE
- 5G networks: Network Densification, Millimetre Wave, MIMO
- Convex Optimization and its Application in 5G networks

MODULE 3 (9L)

- NETWORK AND TRANSPORT LAYER PROTOCOLS: Mobile IPv4, Mobile IPv6 and TCP over Wireless Networks: ATCP, ITCP, MTCP and others.
- WLAN: IEEE 802.11 Wireless LANs Physical and MAC layer, 802.11 MAC Modes (DCF and PCF) IEEE 802.11 standards, Architecture and protocols, Infrastructure vs. Adhoc Mode, Hidden Node and Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues.
- Cognitive Radio Networks: Analysis of Cognitive Channel Allocation Algorithms using Continuous Time Markov Chain.

MODULE 4 (9L)

- WIRELESS ADHOC NETWORK: Definition, Properties, Limitations, Routing Protocols: DSR, DSDV, AODV, TORA, etc. Introduction to Vehicular Adhoc Networks.
- WIRELESS SENSOR NETWORKS: Introduction, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS Overview.
- WIRELESS PANs: Bluetooth and Zigbee.
- SECURITY: Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in wireless communication.

References:

1. Stallings, William. Wireless communications and networks. Pearson Education India, 2009.
2. Rappaport, Theodore S. Wireless communications: principles and practice. Vol. 2. New Jersey: prentice hall PTR, 1996.
3. Schiller, Jochen H. Mobile communications. Pearson education, 2003.
4. Perkins, Charles E. Ad hoc networking. Vol. 1. Reading: Addison-wesley, 2001.
5. Karl, Holger, and Andreas Willig. Protocols and architectures for wireless sensor networks. John Wiley and Sons, 2007.
6. Boyd, Stephen. Convex optimization. Cambridge university press, 2004.
7. Osseiran, Afif, Jose F. Monserrat, and Patrick Marsch, eds. 5G mobile and wireless communications technology. Cambridge University Press, 2016.

Course Name : Introduction to Intelligent Systems					
Course Code: CSEN5133					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of the course the student should be able to:

1. Understand the basic features / attributes that an intelligent system should have and how those attributes can be incorporated to the system.
2. Comprehend the importance of knowledge as far as intelligence is concerned.
3. Apply this knowledge so that it can be used to infer new knowledge.
4. Apply various searching algorithms as and when required
5. Understand the basic principles of various learning algorithms
6. Design and evaluate the performance of various heuristics in different application domain

Module I: [9L]

- Introduction [1L] – Definition of AI, Intelligent Behavior Turing Test, Typical AI Problems, Various AI Approaches, Limits of AI.
- Introduction to Intelligent Agents [1L] - Agents and environment, Agent Architecture, Agent Performance, Rational Agent, Nature of Environment, Simple Reflex Agent, Goal Based Agent, Utility Based Agent.
- Knowledge Representation and Propositional Logic [2L] - Knowledge representation issues, Approaches to knowledge representation, Propositional Logic – its syntax and semantics, Inference rules, Application of those rules, Limitation of Propositional Logic.
- Problem Solving using Single Agent Search [2L] - Introduction to State-space search, state-space search notation, search problem, Formulation of some classical AI problems as a state space search problem, Explicit Vs. Implicit State space.
- Uninformed Search Techniques [3L] - Basic Principles, Evaluating parameters, BFS, DFS, Depth Limited Search, Iterative Deepening DFS, Uniform Cost Search and Bidirectional Search, Properties of various search methods and their comparative studies.

Module II: [9L]

- Informed Search Methods [5L] - Basic Principles, Heuristics, Best First Search – Greedy Best First, A* Search, their Properties, Admissible and Consistent heuristic, Local Search Techniques – Hill climbing and Simulated Annealing, Comparison with other methods
- Problem Solving using Two Agent Search [2L] - Adversarial Search – Game Tree, MINIMAX Algorithm, Alpha-Beta Pruning, Performance Analysis.
- Constraint Satisfaction Problem [2L] - Definition of CSP, Representation of CSP, Formulation of Various popular problems as CSP, constraint graphs, Solution methods of CSP – Backtracking and Forward Checking, variable and value ordering heuristic, degree heuristic, least-constraining value heuristic, constraint propagation, dependency-directed backtracking

Module III: [9L]

- Knowledge Representation and Predicate Logic [2L] - Syntax and Semantics of FOPL, Representation of facts using FOPL, Clauses, Resolution, Unification methods of inference, Default and Non-Monotonic reasoning.
- Knowledge Representation using Rules [2L] - Rule based system, Horn clauses, Procedural vs. declarative knowledge, forward and backward reasoning, Introduction of logic programming using PROLOG/ LISP.
- Other Representational Formalism [2L] - Inheritable knowledge, Semantic network, Inference in Semantic network, Extending Semantic Network, Frames, Slots as objects.
- Probabilistic reasoning [3L] - Representing knowledge in an uncertain domain, probabilistic inference rules, Naïve Bayes Classifier, Bayesian networks – representation and syntax, semantics of Bayesian net, Fuzzy sets and fuzzy logic.

Module IV: [9L]

- Planning [2L] - Introduction, Simple planning agent, Problem solving vs. planning, Logic based planning, Goal Stack planning, Planning as a search, Total-order vs. partial order planning.
- Learning [5L] - Overview, Taxonomy of learning system, various learning models, learning rules, inductive learning framework, Decision tree based learning, Learning using Neural Network and Genetic Algorithm.

Dr. Subhashis Majumder
Professor and HOD

Course Name : GPU Computing					
Course Code: CSEN5134					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

By attending the course, students would:

1. Understand GPU architectures to recognize its potential use as general purpose computing unit .
2. Design and implement parallel solution for application kernels using CUDA tools in GPU framework.
3. Conceptualize and apply concurrent data structures to design and analyze efficient parallel algorithms for GPUs by amplifying the utilization of constrained warps, thread blocks, SMP registers, etc.
4. Understand different approaches to handle memory and synchronization issues under parallelism in a GPU framework.
5. Conceptualize the Event-based- Synchronization techniques, used in kernel executions
6. to manage overlapping of data transfers.
7. Understand the application of GPU computing in different graph algorithms and deep learning techniques.

Module1: Introduction (9L)

- A short history of supercomputing;
- GPU Introduction; CPU/GPU comparison; GPU Architecture;
- CUDA Introduction: Hardware overview; OpenCL / OpenACC introduction;

Module 2: CUDA/GPU Programming (8L)

- Grids/Blocks and Threads: Kernels Functions; Thread organization and hierarchy; Warps/ Wavefronts, Thread blocks / Workgroups.
- Memory handling; global, local / shared, private, textures, Constant Memory; Strategy for reducing Global Memory Traffic; Memory and Parallelism;

Module3: Performance Considerations (10L)

- Streaming multiprocessors;1D / 2D / 3D thread mapping; Dynamic Partitioning of Streaming Multiprocessors; Data Prefetching;
- Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU.

Module 4: Advanced Topics (9L)

- Case Studies: Graph algorithms, Deep Learning
- Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based- Synchronization - Overlapping data transfer and kernel execution.

Suggested Additional Topics:

- Designing GPU based systems.
- Floating Point considerations in GPU
- Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing
- Debugging GPU Programs. Profiling,

References:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-mei Hwu; Morgan Kaufman;
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman;
3. GPU Computing and Applications: Yiyu Cai, Simon See; Springer;

Course Name : Image Processing					
Course Code: CSEN5135					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of the course the student should be able to:

1. Get detail exposure to and understanding of various applications of image processing in industry, medicine, and defense.
2. Learn the digital processing algorithms and techniques in image enhancement and image restoration,
3. Able to understand various algorithms used in image compression, segmentation and morphology.
4. Acquire an appreciation for the image processing issues and techniques
5. Apply several image processing techniques in solving real world problems.
6. Conduct independent study and analysis of image processing problems and techniques.

Module I (9L) Fundamentals of Image Processing:

- Image Acquisition, Image Model, Sampling, Quantization, Relationship between pixels, distance measures, connectivity , Image Geometry, Photographic film.
- Histogram: Definition, decision of contrast basing on histogram, operations basing on histograms like image stretching, image sliding, Image classification. Definition and Algorithm of Histogram equalization.

Image Transforms:

- A detail discussion on Fourier Transform,Wavelet transform, DFT,FFT, properties. A brief discussion on WALSH transform, WFT, HADAMARD transform, DCT.

Module II (9L) Image Enhancement: (by SPATIAL Domain Methods):

- Arithmetic and logical operations, pixel or point operations, size operations, Smoothing filters-Mean, Median, Mode filters – Comparative study , Edge enhancement filters – Directorial filters, Sobel, Laplacian, Robert, KIRSCH, Homogeneity and DIFF Filters, prewitt filter, Contrast Based edge enhancement techniques. Low Pass filters, High Pass filters, sharpening filters.

Image enhancement (by FREQUENCY Domain Methods)

- Design of Low pass, High pass, EDGE Enhancement, smoothening filters in Frequency Domain. Butter worth filter, Homomorphic filters in Frequency Domain, advantages of filters in frequency domain, comparative study of filters in frequency domain and spatial domain.

Module III (9L) Image compression

- Definition, A brief discussion on – Run length encoding, contour coding, Huffman code, compression due to change in domain, compression due to quantization , Compression at the time of image transmission. Brief discussion on:- Image Compression standards.

Module IV (9L) Image Segmentation:

- Definition, characteristics of segmentation. Detection of Discontinuities, Thresholding Pixel based segmentation method. Region based segmentation methods – segmentation by pixel aggregation, segmentation by sub region aggregation, histogram based segmentation, spilt and merge technique. Use of motion in segmentation (spatial domain technique only).

Morphology:

- Dilation, Erosion, Opening, closing, Hit-and-Miss transform, Boundary extraction, Region filling, connected components, thinning, Thickening, skeletons , Pruning Extensions to Gray – Scale Images, Application of Morphology in image processing.

<u>Text Books:</u>

1. Digital Image Processing , by Rafael C. Gonzalez and Richard E. Woods Addision Wesley .
2. Digital Image Processing by S. Sridhar, Oxford University Press.

<u>References:</u>

1. Fundamentals of Electronic Image Processing by Arthyr –R – Weeks, Jr. (PHI)
2. Image processing, Analysis, and Machine vision by Milan Sonka vaclan Halavac Roger Boyle, Vikas Publishing House.

CSEN5131 – CSEN5140	Professional Elective II
CSEN5141	Data Science
CSEN5142	Distributed Systems
CSEN5143	Wireless Sensor Networks
CSEN5144	Digital Forensics
CSEN5145	Computational Biology

Course Name : Data Science					
Course Code: CSEN5141					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

On completion of the course the student should be able to:

1. Explain how data is collected, managed and stored for data science;
2. Understand the key concepts in data science, including their real-world applications and some of the popular techniques used by data scientists;
3. Build skills in data management;
4. Demonstrate proficiency with statistical analysis of data;
5. Develop ability to build and assess data-based models;
6. Apply data science concepts and methods to solve real-world problems;

Module 1: Data Science Process (9L)

- Overview – Benefits and Uses, Facets of Data, Big Data Ecosystem;
- Data Scientist's Role in Major Steps – Goal Setting, Data Retrieval, Data Preparation, Data Exploration, Data Modeling, Data Presentation;

Module 2: Statistics for Data Science (9L)

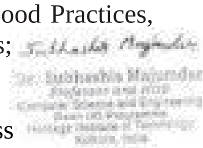
- Exploratory Data Analysis (EDA) – Structured Data, Rectangular Data, Location, Variability, Data Distribution, Binary and Categorical Data, Correlation, Multiple Variables ;
- Sampling Distributions – Random Sampling, Bias, Sampling Distribution and Central Limit Theorem (CLT), Bootstrap, Confidence Interval; Different Distributions –Binomial / Poisson / Exponential / Normal / Student's t / Long-Tailed;

Module 3: Algorithms for Data Science (9L)

- Regression – Simple Linear, Multiple Linear, Polynomial; Prediction using Regression (Logistics Regression); [Non-linear Regression to be covered in detail in ML]
- Classification – K Nearest Neighbors (k-NN), Naive Bayes Classification; Evaluating Classification Models – Accuracy, Precision, Recall, Specificity, Receiver / Operating Characteristics (ROC / OCC) Curve and Area Under Curve (AUC), Precision-Recall (PR) Curve;
- Unsupervised Learning – K-Means Clustering, Hierarchical Clustering and Dendrogram, Principal Component Analysis (PCA); [PCA to be covered in detail in ML]

Module 4: Data Visualization (9L)

- Visual Analytics -- Definition, Roles and Lifecycle / Process / Workflow of Visualization, Common Display Types with Examples;
- Visual Encoding – Guidelines, Mackinlay's Retinal Variables, Mapping Effectiveness; Some Good Practices, Recommendations and Principles related to Graphical Excellence, Some Visualization Techniques;



References:

1. "Introducing Data Science"; Davy Cielen, Arno D Meysman and Mohamed Ali; Dreamtech Press
2. "Practical Statistics for Data Scientists"; Peter Bruce and Andrew Bruce; O'Reilly Media Inc.
3. "Doing Data Science"; Cathy O'Neil and Rachel Schutt; O'Reilly Media Inc.
4. "A First Course in Probability" 8th ed.; Sheldon Ross; Pearson Education Inc.
5. "Mining of Massive Datasets" v2.1; Jure Leskovek, Anand Rajaraman and Jeffrey Ullman; Cambridge University Press

Course Name : Distributed Systems					
Course Code: CSEN5142					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

Upon successful completion of this course students should be able to:

1. Identify the introductory distributed database concepts and its structures, and relate the importance and application of emerging database technology
2. Describe terms related to distributed object database design and management.
3. Produce the transaction management and query processing techniques in DDBMS.
4. Demonstrate knowledge of the basic elements and concepts related to distributed system technologies
5. Demonstrate knowledge of the core architectural aspects of distributed systems and underlying components of distributed systems (such as RPC, file systems)
6. Design and implement distributed applications and demonstrate experience in building large-scale distributed applications
7. Use and apply important methods in distributed systems to support scalability and fault tolerance

Module 1:

- Distributed Systems [4L] - Introduction to distributed computing systems. DCS design goals, Transparencies, Fundamental issues
- Distributed Coordination [5L] - Temporal ordering of events, Lamport's logical clocks, Vector clocks; Ordering of messages, Physical clocks, Global state detection

Module 2:

- Process synchronization [5L] - Distributed mutual exclusion algorithms
- Inter-process communication [5L] - Message passing communication, Remote procedure call, Transaction communication, Group communication; Broadcast atomic protocols.

Module 3:

- Distributed Scheduling [5L] - Issues in Load Distributing, Classification of Load Distributing algorithm, Load Balancing vs Load Sharing, Preemptive vs Non-Preemptive transfers
- Distributed file systems [2L] - Introduction, Goal, Architecture, File accessing, sharing, caching, replication.
- Naming [2L] - Design Issues: Naming and Name Resolution, Name Server, Cache Consistency.

Module 4:

- Distributed Databases [8L] - Storage structures for distributed data, data fragmentation, Transparency of distributed architecture, Distributed query processing, and Transaction management in distributed environment, Recovery and Concurrency control, locking protocols, Deadlock handling.

Book:

Text Books:

1. Ceri and Pellagetti: Distributed Database: Principles and Systems, TMH
2. Sukumar Ghosh: Distributed Systems: An Algorithmic Approach, CRC Press
3. Pradeep K Sinha: Distributed Operating Systems Concepts and Design, PHI

Reference:

1. Silberschatz Korth, Sudarshan: Database System Concepts, TMH
2. Connolly and Begg: Database Systems: A practical approach to design, implementation and management, Pearson
3. M. Singhal, N.G. Shivarathri : Advanced Operating Systems, McGraw Hill

Course Name : Wireless Sensor Networks					
Course Code: CSEN5143					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After the completion of this course, students should be able to:

1. Understand the fundamental concepts of wireless sensor networks.
2. Understand the architecture of sensor nodes
3. Acquire basic knowledge and learn the protocols of various layers.
4. Be able to design and implement sensor networks for various application setups.
5. Evaluate the performance of sensor networks and identify bottlenecks
6. Be able to program sensor nodes as per requirement

Module I: Introduction (8L)

- Basic concepts of wireless sensor networks - Motivations, Applications, Performance metrics;
- History and Design factors;
- Architecture of a sensor node;
- Different sensing scenarios using WSN;
- Challenges in implementing WSNs;

Module II: Medium Access Control Protocol design (8L)

- Characteristics of WSN MAC related properties ;
- MAC performance issues ;
- MAC protocols for sensor networks – Schedule based and Random Access based.
- WSN protocols: synchronized, duty-cycled;
- Content based and Contention free MAC protocols;

Module III: Routing protocols for WSN (8L)

- Issues with the adoption of ad hoc routing protocols;
- Data-centric routing ; Position-based / Geographic routing ; Clustering-based routing algorithm, QoS based Routing Protocols.

Module IV: Advanced Topics (12L)

- Security requirements in WSNs ; Different types of attacks in WNs ; Security protocols for WSNs.
- Time Synchronization: Requirements and challenges; Basic Ideas; Various protocols;
- Coverage problem in WSNs: OGDC coverage algorithm ; Placement problem;
- Topology management in WSNs : Different classifications relevant algorithms ; Topology discovery, sleep-cycle management, and clustering;

Suggested Additional Topics:

- Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis; MAC Protocol Analysis using Markov chains;
- Sensor Network Programming: Node centric Programming; Macroprogramming; Dynamic reprogramming;
- Introduction to ns-3: Description of the ns-3 core module and simulation example.
- Opportunistic Routing Analysis: Analysis of opportunistic routing (Markov Chain)
- Real Life Deployment; Underwater Sensor Nodes vs Terrestrial Sensor Nodes;
- Power Management.

References:

1. W. Dargie and C. Poellabauer, Fundamentals of Wireless Sensor Networks-Theory and Practice, Wiley 2010.
2. K. Sohraby, D. Minoli and TaiebZnati, “Wireless Sensor Networks -Technology, Protocols, and Applications”, Wiley Interscience 2007.
3. Fei Hu and Xiaojun Cao, “Wireless Sensor Networks: Principles and Practice”, CRC Press, 2010.
4. Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, “Wireless Sensor Network Technologies for the Information Explosion Era”, Springer 2010.
5. H. Karl and A. Willig, “Protocols And Architectures For Wireless Sensor Networks “, Willey, 2012
6. Q., Muller and Chen, “Security in Wireless Networks and Systems”, Willey, 2011.
7. Stojmenovic, “Wireless Sensor and Actuator Networks: Algorithms and Protocols for Scalable Coordination and Data Communication”, Willey, 2010.

Course Name : Digital Forensics					
Course Code: CSEN5144					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After the completion of this course, students should be able to:

1. Introducing basic concepts of digital forensic science
2. Exploring the specific areas of media, network and code forensics
3. Examining the role of digital forensics in public and private investigations
4. Examining the potential benefits, limitations and risks of digital forensics
5. Increasing awareness of managerial issues raised by the use of digital forensics
6. Enabling students to create disk images, recover deleted files and extract hidden information.
7. Introducing students to the current research in computer forensics. This will encourage them to define research problems and develop effective solutions.

Module 1: Introduction (8L)

- Understanding the Digital Forensics Profession and Investigations; Forensics science, computer forensics, and digital forensics;
- Processing Crime and Incident Scenes; analysis of cyber-criminalistics area, holistic approach to cyber-forensics;

Module 2: Cyber Crime Scene Analysis (10L)

- Understanding Storage Formats for Digital Evidence; Determining the Best Acquisition Method; Using Acquisition Tools: Linux Boot CD; Remote Network Acquisition; Understanding various acquisition tools;
- Evidence Management and Presentation Basics: Identifying Digital Evidence, Rules of Evidence, Understanding Concepts and Terms Used in Warrants;

Module 3: Details of Evidence Management and Presentation (8L)

- Determining the devices to be seized; Getting Location Description; Determining necessary tools; Processing an Incident or Crime Scene; Storing Digital Evidence; Managing Evidence; Obtaining a Digital Hash;
- Sample Criminal Investigation;

Module 4: Digital Forensics Analysis and Validation (10L)

- Approaching Digital Forensics Cases; Analyzing and Validating Forensic Data; Addressing Data-Hiding Techniques; Understanding Steganalysis Methods; Recovering Passwords;
- Network Forensics; Live Acquisition; Using Network Logs and Packet Analyzers;
- E-mail and Social Media Investigations;
- Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.

Suggested Additional Topics:

- Mobile Forensics: mobile forensics techniques, mobile forensics tools.
- Recent trends in mobile forensic technique and methods to search and seizure of electronic evidence
- Working with Windows and CLI Systemsfor File System Recovery
- Understanding Graphic File formats and their recovery.

References:

1. File System Forensic Analysis, by Brian Carrier, Addison-Wesley
2. Handbook of Digital Forensics and Investigation, by Eoghan Casey, Academic Press
3. Guide to Computer Forensics and Investigations 5th Edition, Nelson, Phillips, Steuart, Cengage Learning, 2015
4. The Basics of Digital Forensics, John Sammons, Elsevier
5. Computer Forensics: Computer Crime Scene Investigation, John Vacca, Laxmi Publications
6. Digital Forensic Course Materials from http://mgt2.buffalo.edu/departments/mss/djmurray/mgs610/syllabus.htm

Course Name : Computational Biology					
Course Code: CSEN5145					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. To become familiar with the use of a wide range of biological databases and their applicability.
2. To understand the storage and retrieval methods of biological data from various biological databases.
3. To study structures of Genes, Molecule codes, DNA Structure.
4. To analyze various existing Graph Algorithms for DNA Sequencing and to compare among different DNA Sequences.
5. To explore different sequenced databases like FASTA, BLAST and evaluate their relevance with research problems.
6. To apply the learned methods to pertinent research problems in various domains.

Module I: (9L)

- Genes, Molecule codes, DNA Structure. DNA and Proteins. Analyzing DNA: copying, cutting and pasting, measuring, probing.
- Exhaustive Search: Restriction Mapping Algorithms, Motif Finding, Finding Median String.

Module II: (9L)

- Greedy Algorithms: Genome Rearrangements, Sorting by Reversals. Greedy approach to Motif Finding.
- Dynamic Programming Algorithms: DNA Sequence Comparison, Edit Distance and Assignments, Longest Common Subsequence, Global Sequence Alignment, Scoring alignments, Local Sequence Alignment, Alignment with Gap Penalties, Multiple Penalties, Gene Prediction, Spliced Alignment.
- Divide and Conquer Algorithms. Sorting, Sequence Alignment, Four-Russians Speedup, Constructing alignments in sub-quadratic time.

Module III: (9L)

- Graph Algorithms: DNA Sequencing, Shortest Superstring Problem, DNA arrays as an alternative sequencing technique. Sequencing by Hybridization: Hamiltonian and Eulerian Path Problems. Protein sequencing and identification. Peptide sequencing problem. Spectrum Graphs: Spectral Convolution, Spectral Alignment.

Module IV: (9L)

- Combinatorial Pattern Matching. Repeat Finding, Exact pattern matching, Keyword trees. Suffix trees. Heuritic similarity search, Approximate pattern matching. Sequenced databases and querying: FASTA, BLAST. Clustering and trees. Gene Expression Analysis, Hierarchical Clustering, Evolutionary trees. Distance based tree reconstruction. Reconstructing trees from additive matrices.
- Evolutionary treesand hierarchical clustering. Charcter based tree reconstruction. Small and Large Parsimony problem.

References:

1. Neil C. Jones and Pavel A. Pevznel: An Introduction to Bioinformatics Algorithms, The MIT Press, 2004.
2. Dan Gusfield: Algorithms on Strings, Trees and Sequences. Cambridge University Press, 1999

Course Name : Advanced Data Structures Lab					
Course Code: CSEN5151					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

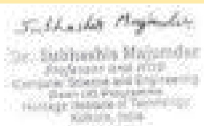
Course Outcomes:
At the end of this lab session, the student will
1. be able to design and analyze the time efficiency of various data structures
2. be capable to identity the appropriate data structure for a given problem
3. be able to write program with appropriate data structures for a given problem
4. have practical knowledge on the applications of data structures

A tentative outline for this laboratory is given below:
- Assignments on the application of array data structure to sort a set of elements using different sorting methods (e.g., bubble sort, insertion sort, selection sort)
- Assignments on the application of array data structure to search an element in a set of elements using different searching methods (e.g., linear search, binary search)
- Implementation of stack and queue using array and linked list data structures
- Assignments on the implementation of binary tree using array and linked list and traversal of the tree
- Implementation of hashing where collision resolution is done using open addressing method
- Implementation of KMP algorithm for pattern matching
- Application of one/ two data structures in real life applications

Course Name : Machine Learning Lab					
Course Code: CSEN5181					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcomes:
At the end of this lab session, the student will be able to
1. write code the machine learning algorithm in C or Python.
2. understand and conceptualize the methods of machine learning and its applications.
3. design simple algorithms for pattern classification, code them with Python programming language and test them with benchmark data sets.
4. write program analyze and evaluate simple algorithms for pattern classification.
5. analyze and evaluate simple algorithms of estimation.
6. design complex machine learning algorithms using tools like Excel, R, TensorFlow, Weka.

List of Experiments:
- Regression (single and Multiple Variables) linear and non-liner;
- Logistic regression
- Classifiers - K-NN; Naïve Bayes Classifier; Perceptron; Multi Layer Perceptron.
- Clustering Algorithms - K-Means; DB-Scan
- Familiarization with a few ML Tools Excel; WEKA; R; Python; TensorFlow
- Applications of ANN and SVM using ML tools



Course Name : Advanced Wireless and Mobile Networks Lab					
Course Code: CSEN5182					
Contact Hours Per Week	L	T	P	Total	Credit Points
	0	0	4	4	2

Course Outcomes:

1. The students should get familiar with the various network simulators like ns2 and QualNet.
2. To learn to model and simulate various network topologies
3. To learn how to evaluate MAC and network protocols using network simulation software tools.
4. To learn the methodology to develop new MAC and network protocols and simulate them in the network simulators.

Syllabus:

- Network Simulator (NS)
  - Installation of Network Simulator ns 2
  - Familiarization with ns 2
  - Learn programming in OTCL
  - Setup wired and wireless networks using existing protocols in OTCL
  - Observe the variation in the network performance of wireless ad hoc networks for various routing protocols
  - Observe the variation in the network performance of vehicular ad hoc networks for various routing protocols
- Real time network simulator Qualnet
  - Familiarization with the real time network simulator Qualnet.
  - Learn to setup wired and wireless networks, add applications, run scenarios, obtain results and analyze them.
  - Observe the variation in the network performance of wireless ad hoc networks forvarious routing protocols.
  - Observe the variation in the network performance of vehicular ad hoc networks for various routing protocols.

Course Name : Introduction to Intelligent Systems Lab					
Course Code: CSEN5183					
Contact Hours Per Week	L	T	P	Total	Credit Points
	0	0	4	4	2

Course Outcomes:

At the end of this course, students are expected to

1. get a good flavor of logical programming by using PROLOG/ LISP
2. apply that knowledge to solve some intelligent puzzles
3. learn to model simple intelligent systems
4. apply search algorithm in developing intelligent systems

In this laboratory students will be familiarized with PROLOG/ LISP language.

- Introduction to PROLOG facts and rules with the help of a simple family tree: how the goals are given in PROLOG; some simple queries on the family tree formation of recursive definition; how PROLOG executes the goals; simple assignments
- how PROLOG deals with problems with numbers – integers, real; with some examples
  Introduction to LIST structure: how PROLOG implements LIST; some simple assignments on LIST
- some more complex assignments on LISTIntroduction to Accumulator – simple assignments
- Introduction to CUT with simple assignments; implementation of sorting algorithms
- implementation of graph search algorithms like DFS, BFS; Some application of BFS. DFS
- Implementation of some well known puzzles, like 8-queens problem, Towers-of-Hanoi problem, Missionaries and Cannibals problem etc.
- Introduction to LISP
- Some simple assignments on LISP

References:

1. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India.

Course Name : Advanced Wireless and Mobile Networks Lab					
Course Code: CSEN5182					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcomes:

1. The students should get familiar with the various network simulators like ns2 and QualNet.
2. To learn to model and simulate various network topologies
3. To learn how to evaluate MAC and network protocols using network simulation software tools.
4. To learn the methodology to develop new MAC and network protocols and simulate them in the network simulators.

Syllabus:

- Network Simulator (NS)
  - Installation of Network Simulator ns 2
  - Familiarization with ns 2
  - Learn programming in OTCL
  - Setup wired and wireless networks using existing protocols in OTCL
  - Observe the variation in the network performance of wireless ad hoc networks for various routing protocols
  - Observe the variation in the network performance of vehicular ad hoc networks for various routing protocols
- Real time network simulator Qualnet
  - Familiarization with the real time network simulator Qualnet.
  - Learn to setup wired and wireless networks, add applications, run scenarios, obtain results and analyze them.
  - Observe the variation in the network performance of wireless ad hoc networks forvarious routing protocols.
  - Observe the variation in the network performance of vehicular ad hoc networks for various routing protocols.

Course Name : Introduction to Intelligent Systems Lab					
Course Code: CSEN5183					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcomes:

At the end of this course, students are expected to

1. get a good flavor of logical programming by using PROLOG/ LISP
2. apply that knowledge to solve some intelligent puzzles
3. learn to model simple intelligent systems
4. apply search algorithm in developing intelligent systems

In this laboratory students will be familiarized with PROLOG/ LISP language.

- Introduction to PROLOG facts and rules with the help of a simple family tree: how the goals are given in PROLOG; some simple queries on the family tree formation of recursive definition; how PROLOG executes the goals; simple assignments
- how PROLOG deals with problems with numbers – integers, real; with some examples
  Introduction to LIST structure: how PROLOG implements LIST; some simple assignments on LIST
- some more complex assignments on LISTIntroduction to Accumulator – simple assignments
- Introduction to CUT with simple assignments; implementation of sorting algorithms
- implementation of graph search algorithms like DFS, BFS; Some application of BFS. DFS
- Implementation of some well known puzzles, like 8-queens problem, Towers-of-Hanoi problem, Missionaries and Cannibals problem etc.
- Introduction to LISP
- Some simple assignments on LISP

References:

1. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India.

Course Name : GPU Computing Lab					
Course Code: CSEN5184					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcomes:

By attending the course, students would:

1. learn concepts in parallel programming,
2. gain the knowledge of implementation of programs on GPUs,
3. have skills for debugging and profiling parallel programs on CUDA.

Experiments will be conducted under Linux on any (say, ARCUS) GPU cluster. The header files (helper_cuda.h, helper_string.h) which come from the CUDA SDK will be used. They provide routines for error-checking and initialization.

- **Lab 1: Application**: a trivial "hello world" example
- **CUDA aspects**: launching a kernel, copying data to/from the graphics card, error checking and printing from kernel code
- **Lab 2: Application**: Monte Carlo simulation using NVIDIA's CURAND library for random number generation
- **CUDA aspects**: constant memory, random number generation, kernel timing, minimising device memory bandwidth requirements
- **Lab 3: Application**: reduction
- **CUDA aspects**: dynamic shared memory, thread synchronization;
- **Lab 4**: Matrix-matrix operation (CUDA)
- **Lab 5**: Application: using the CUBLAS and CUFFT libraries
- **Lab 6**: Matrix-matrix operation via cuBLAS (CUDA)
- **Lab 7: Application**: tri-diagonal equations
- **Lab 8**: pattern matching
- **Lab 9 and Lab 10**: streams and OpenMP multithreading:

References:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-mei Hwu; Morgan Kaufman.
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman
3. GPU Computing and Applications: Yiyu Cai, Simon See; Springer.
4. Web Limk: https://people.maths.ox.ac.uk/gilesm/cuda/

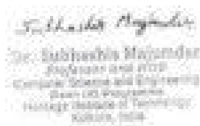
Course Name : Image Processing Lab					
Course Code: CSEN5185					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcomes:

1. Students will learn to convert one image form to another image form.
2. Able to learn various kinds of image enhancement and image restoration techniques.
3. They will learn various techniques of image compression, image segmentation etc.

List of Experiments:

- Display of Grayscale Images.
- Histogram Equalization.
- Non-linear Filtering.
- Edge detection using Operators.
- 2-D DFT and DCT.
- Filtering in frequency domain.
- Filtering in spatial domain.
- Display of color images.
- DWT of images.
- Segmentation using watershed transform.
- Image Compression.
- Applications of image zooming and image shrinking etc.



M. Tech. Detailed Syllabus - Semester II

Subject Name: Advanced Algorithms					
Paper Code: CSEN5201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
After completion of the course, students would be able to:
1. Remember time complexities of various existing algorithms in different situations
2. Understand the basic principles of different paradigms of designing algorithms
3. Apply mathematical principles to solve various problems
4. Analyze the complexities of various algorithms
5. Evaluate the performance of various algorithms in best case, worst case and average case
6. Create/ Design a good algorithm for a new problem given to him/ her

Module I [9L]
- **Basic Concepts [3L]:** Review of basic data structures and algorithms, worst-case and average-case analyses, asymptotic complexity, Big-O, Big-Theta, Big-Omega and small-o notations and their properties, introduction to recurrences, suitable examples.
- **Sorting and Selection [4L] :** merge sort, quick sort, heap sort and their analysis; priority queues, lower bounds for comparison-based sorting, median and order statistics, selection of *k*-th largest element.
- **Searching [2L]:** Linear Search, Binary Search, Analysis in best case, worst case and average case.

Module II [9L]
- **Graph Algorithms [3L] :** Graph traversal algorithms: BFS and DFS; topological sorting of cycle-free graphs, strongly connected components.
- **Greedy Method [6L]:** Elements of the greedy strategy, fractional knapsack problem; Shortest Path Algorithms: Dijkstra's and Bellman Ford with correctness proofs; Minimum cost spanning trees: Prim's and Kruskal's algorithms and their correctness proofs.

Module III [9L]
- **Dynamic Programming [4L]:** Basic Principles, Matrix-chain multiplication algorithm, All pairs shortest path algorithm - Floyd-Warshall algorithm, LCS Problem; Some more problems.
- **Algebraic Operations [2L]:** Integer multiplication, GCD computation using Euclid's algorithm, polynomial evaluation, Strassen's matrix multiplication algorithm.
- **Amortized Analysis [3L]:** Aggregate, Accounting and Potential Methods, Example problems.

Module IV [9L]
- **Flows in Networks [2L]:** Basic Concepts, maxflow – mincut theorem, Ford-Fulkerson method, Edmond-Karp maximum-flow algorithm.
- **NP-completeness [3L]:** Informal concepts of deterministic and non-deterministic algorithms, P and NP, NP-completeness, Cook's theorem, examples of NP-complete problems.
- **Approximation algorithms [3L]:** Necessity of approximation schemes, performance guarantee, Approximation algorithms for 0/1 knapsack, vertex cover, TSP.
- **Recent Trends [1L]:** Discussion on recent searching and sorting techniques by applying recently proposed data structures.

References:

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest, C Stein: Introduction to Algorithms (2nd Ed), MIT Press, 2001.
2. G Brassard, P Bratley: Introduction to Algorithmics, Pearson Prentice Hall, 1996
3. D. E. Knuth: The Art of Computer Programming (2nd Ed or later), vol 1-3, Addison-Wesley
4. J Kleinberg, E Tardos: Algorithm Design, Pearson, 2006

Subject Name: Soft Computing					
Paper Code: CSEN5202					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
After completion of course, students would be able to:
1. Learn (remember) and understand soft computing techniques and their roles in building intelligent machines.
2. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
3. Design (create) methodology to solve optimization problems using genetic algorithms
4. Analyze and evaluate solutions by various soft computing approaches for a given problem.
5. Understand various models of artificial neural networks and their applications in solving pattern recognition and machine learning problems.
6. Develop intelligent systems leveraging the paradigm of soft computing techniques.

Module I: (L9): Introduction to Soft Computing and Fuzzy Logic
Evolution of Computing, Soft Computing Constituents. Fuzzy Sets, Operations on Fuzzy Sets, and Membership Functions, Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inferences, Fuzzy logic controller design.
Module II: (L9): Neural Networks
Introduction to Artificial Neural Network (ANN). Different ANN architectures, Traing techniques for ANNs (Supervised Learning Neural Networks, Radial Basis Function Networks, Unsupervised Learning Neural Networks, Self organizing map).
Module III (L9): Genetic Algorithms
Introduction to Genetic Algorithms (GA), Binary coded GA, Real coded GA, Other coding methods, Non-dominated Sorted GA, Solving single-objective optimization problems using GAs.
Module IV (L9): Applications and Advanced Soft Computing tools
Concept of multi-objective optimization problems (MOOPs) and issues of solving them, GAs to solve MOOPs, neural network in deep learning, Neuro-Fuzzy Hybrid system.
References:

1. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall, 1995.
2. Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010
3. Fuzzy Logic for Embedded Systems Applications, Ahmed M. Ibrahim, Elesvier Press, 2004.
4. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000
5. Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, Pearson Education, 2002
6. Neural Networks, Fuzzy Logis and Genetic Algorithms : Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India, 2007.
7. Soft Computing, D. K. Pratihar, Narosa, 2008.
8. Neural Networks and Learning Machines, (3rd Edn.), Simon Haykin, PHI Learning, 2011.

Professional Elective III

CSEN5231 – CSEN5235	Professional Elective III
CSEN5231	Data Preprocessing and Analysis
CSEN5232	Secure Software Design and Enterprise Computing
CSEN5233	Computer Vision
CSEN5234	Theory of Computation
CSEN5235	Computational Geometry

Subject Name: Data Preprocessing and Analysis					
Paper Code: CSEN5231					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

After completion of course, students would be able to

1. Acquire knowledge in a broad range of methods based on statistics and informatics for data preprocessing and analysis and tools for visualizing the main characteristics of data.
2. Understand the whole process line of gathering relevant data, preprocessing the data, performing exploratory analysis on the data and visualizing the implicit knowledge extracted from data.
3. Apply suitable methods for unveiling the underlying structure of the data, testing underlying assumptions in various fields.
4. Analyze the results of experiment with the help of various visualization tools and statistical tests.
5. Evaluate the performance of not only a computational method after obtaining different results by using different parameter values in order to choose the correct parameter value, but also, all similar methods in order to find out the best performing algorithm for a dataset.
6. Get familiar with relevant literatures, derive theoretical properties of the existing methods and come up with novel approach or pipeline for analyzing data across various fields by solving assignment problems.

Module I (7L): Data Gathering and Preparation

Data formats- Structured, semi-structured and unstructured data format; **Parsing and transformation**- Need of Parsing, Text markup language and parser, Extensible mark-up language and parser; **Scalability**- Goals of a scalable platform, when to scale your database, vertical scaling, read scaling; **Real-time issues**- Real-time event transfer, Real-time situation discovery, Real-time analytics, Real-time decision making, Real-time responses.

Module II (7L): Data Cleaning

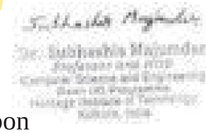
Importance of data cleaning, Data quality dimensions (Accuracy, Completeness, Currency and Consistency); **Classification of Data quality problems (Single-source and Multi-source problems)**- Consistency checking, Heterogeneous and missing data; **Data Cleaning Approaches:** Data Transformation and segmentation.

Module III (15L): Exploratory Analysis

Descriptive statistics- Central Tendency, variation, shape; **Comparative statistics-** Parametric (Paired t-test, Unpaired t-test, Repeated measures ANOVA, One-way ANOVA, Pearson correlation) vs non-parametric tests (Wilcoxon- Signed Ranks test, Mann-Whitney test, Friedman test, Kruskal-Wallis test, Spearman correlation, Chi-Square test/ Fisher's test); **Clustering and association**- Overview of clustering, distance metrics, k-means and hierarchical clustering; **Hypothesis generation-** Introduction, Null hypothesis, alternate hypothesis, Types of errors. Multiple testing- Methods for addressing multiple testing (Family wise error rate and False discovery rate).

Module IV (7L): Visualization

Designing visualizations- Steps in designing visualization, Problems in Designing Effective Visualization **Time series-** Line Graph, Stacked Area Chart, Bar Chart, Gantt Chart, Stream Graph, Heat Map, Polar Area Diagram; **Geolocated data-** Introduction spatial data, Point phenomena, line phenomena, area phenomena, Cartograms; **Correlations and connections-** Marimekko chart, Parallel Coordinates plot, Radar chart, Venn diagram, bubble chart, heatmap, scatter plot, arc diagram, brainstorm, chord diagram, connection map, network diagram, non-ribbon chord diagram, tree diagram; **Hierarchies and networks-** Space and Non-space filling methods, Node-link graphs, Matrix representation of graphs; **Interactivity-** Interaction operators, Interaction operands and spaces.



References:

1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt, Wiley Interscience.
2. Data Quality: Concepts, Methodologies and Techniques, by Carlo batini and Monica Scannapieca, Springer.
3. Fundamentals of Descriptive Statistics, by Zealure C. Holcomb, Routledge.
4. Visualizing Data: Exploring and Explaining Data with the Processing Environment, by Ben Fry, O’REILLY’.

Subject Name:	Secure Software Design and Enterprise Computing				
Paper Code:	**CSEN5232**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

COURSE OUTCOMES:
After completion of course, students would be able to

1. Understand methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.
2. Study various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic.
3. Know essential techniques for reducing and avoiding system and software security problems,
4. Evaluate various enterprise application design and development tools and standard practices.
5. Review techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
6. Solve enterprise scale problems emanating from lapses in security requirements and information system management practices.

Module 1:
Secure Software Design **(10L)**
Identify software vulnerabilities and perform software security analysis;
Exposure to security programming practices;
Basics of fundamental software security design concepts;
Perform security testing and quality assurance.
Domain Model for Security Risk Management;
Security Risk; Security Requirements and Metrics;
Security Modeling: Understanding security goals and business activities;
Designing secure system functions and behavior; Role-based access control ;

Module 2: **(8L)**
Enterprise Application Development
Describe the nature and scope of enterprise software applications;
Explore technologies available for the presentation, business and data tiers of an enterprise software application;
Design and build a database using an enterprise database system;
Develop components at the different tiers in an enterprise system; Design and develop a multi-tier solution to a problem using technologies used in enterprise system.

Module 3: **(8L)**
Enterprise Systems Administration
Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment;
Monitor server resource utilization for system reliability and availability;
Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

Module 4: **(10L)**
Enterprise Network Infrastructure
Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.
Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.
Case study: DNS server, DHCP configuration and SQL injection attack.

References:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones and Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.
3. Principles of Secure Software Design: Dr. Raimundas Matulevičius
4. Architecting Applications for the Enterprise: Dino Esposito and Andrea Saltarello; Microsoft Press;
5. Enterprise Applications Administration: Jeremy Faircloth; Morgan Kaufmann publishers;
6. RedHat Linux Networking and System Administration: Terry Collings and Kurt Wall; Wiley Publishing;
7. SQL Injection Attacks and Defense: Justin Clarke; Elsevier Publishing;

Subject Name: Computer Vision					
Paper Code: CSEN5233					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

COURSE OUTCOMES:

After completion of course, students would be able to:

1. Learn basic concepts, terminology, theories, models and methods in the field of image analysis and computer vision.
2. Learn and understand shape and region analysis.
3. Apply the vision technology in solving image processing and computer vision problems.
4. Identify the limitations of vision systems.
5. Develop skills to implement boundary detection and motion related techniques.
6. Design successful applications to process and analyze images.

Module I (8L):

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis, Edge detection, Edge detection performance, Hough transform, corner detection.

Module II (7L):

Fourier Transform, Segmentation, Morphological filtering.

Module III (10L):

Feature extraction, shape, histogram, color, spectral, texture, using CVIP tools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing.

Module IV (11L):

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semisupervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.

Recent trends in Activity Recognition, Computational photography, Biometrics.

References:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Deep Learning, by Goodfellow, Bengio, and Courville.
3. Dictionary of Computer Vision and Image Processing, by Fisher et al.

Subject Name:	Theory of Computation				
Paper Code:	**CSEN5234**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

Students who complete the course will demonstrate the ability to do the followings:

1. Design and analyze Deterministic and non-deterministic finite state automata.
2. Understand the correspondence between finite state automata and regular languages.
3. Design context free grammars to generate strings from a context free language and convert them into Chomsky normal forms.
4. Design deterministic and non-deterministic push down automata to recognize context free languages.
5. Construct Touring machines for computable functions.
6. Understand the hierarchy of formal languages, grammars and machines.
7. Distinguish between computability and non-computability and Decidability and undecidability.

Module 1: (9 hours)

Finite State Machines. Basic definitions, state transition diagrams, state tables, Mealy model, Moore model, formal mathematical definition, input alphabet, input strings, concept of language. Recognition of a language by a finite state automaton. Examples of design of FSMs.

Distinction between deterministic and non-deterministic automaton, conversion of a non-deterministic machine to deterministic form. Epsilon transitions and their elimination.

Regular grammars and languages.

Module 2: (8 hours)

Regular Expressions. Definition and properties of regular expressions. Correspondence between regular expressions and finite state machines. Kleene's Theorem.

Types of Languages. The Pumping Lemma for Type 3 languages. Examples of languages that are not regular. Closure properties of regular languages. Decision properties of regular languages.Capabilities and limitations of FSMs.Applications of finite automata.

Module 3: (7 hours)

Context-free grammars. Parse Trees. Pushdown Automata. Deterministic and non-deterministic pushdown automata. Designing PDAs to accept Type 2 languages. Chomsky Normal Form of context-free grammars. Ambiguity of CFLs. Examples of ambiguous grammars.

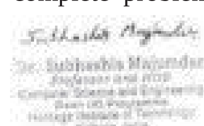
Pumping lemma for CFLs. Examples of languages that are not context-free. Closure properties of CFLs. Decision properties of CFLs.

Module 4: (12 hours)

Turing machines: Church's Thesis. The Turing Machine model. Design of TMs. Variants of the basic TM model. Non-deterministic TMs.

Undecidability. Recursive and recursively enumerable languages. Examples of undecidable problems. Post's Correspondence Problem.

Introduction to Computational Complexity Theory: Intractable Problems. P and NP. NP complete problems. Examples of polynomial-time reductions.



References

1. Michael Sipser, Introduction to the Theory of Computation (3rd ed), PWS Publishing.
2. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.
3. Peter Linz, An Introduction to Formal Languages and Automata (6th ed), Jones and Bartlett Learning.
4. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.

Subject Name:	**Computational Geometry**				
Paper Code:	**CSEN5235**				
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

Students who complete the course will demonstrate the ability to do the followings:

1. Know the common algorithms for solving well-known geometric algorithms.
2. Explain the major geometric algorithms and their analyses.
3. Apply a geometric problem or rather identify whether an algorithm for an existing geometric problem can be useful to solve the problem at hand.
4. Estimate the time and space required for implementing a geometric algorithm to solve a new problem.
5. Weigh between different geometric algorithms to solve a given problem.
6. Develop new algorithms for simple geometric problems.

Module-I:

Preliminaries: [4L]: Basic Euclidean geometry, Basic Visibility Problems , Polygons and Art Gallery Theorem, The Maximal Points Problem , The Plane Sweep Technique and applications (Segment Intersection Problem and Rectangular Union)

Convex Hull Different Paradigms [4L]: Gift wrapping, Quickhull, Graham scan, Incremental algorithm, Preparata-Hong algorithm

Module-II:

Point Location and Triangulation [4L]: Planar Point Location, Triangulation of Arbitrary Polygon, Kirkpatrick's method, trapezoidal decompositions and analysis, history DAGs

Voronoi Diagram and Delaunay Triangulation [3L]: Concepts, Delaunay triangulations. Closest Pairs, Bichromatic Closest Pairs Incremental (randomized) algorithm, Fortune's sweep, Applications.

Randomized Algorithms[3L]: Skip Lists. Randomized Incremental Construction. Planar Point Location. Persistent Data Structures.

Module-III:

Range Searching [6L]: Introduction, Orthogonal Range searching, Priority Search Trees (kd-trees, range trees and range searching, segment trees), Non - Orthogonal Range Searching, Half - Plane Range Query, Well Separated Partitioning, Adding range restrictions. Colored Range Searching

Arrangements and Duality [3L]: Point/line duality, incremental construction of arrangements and the zone-theorem, applications.

Module-IV:

Geometric Approximation [4L]: Dudley's theorem and applications, well-separated pair decompositions and geometric spanners, VC dimension, epsilon-nets and epsilon-approximations

Isothetic Geometry [3L]: Generation, Decomposition and Analysis of the Isothetic Polygon.

Matrix Searching [2L]: Concepts and its applications in different geometric optimization problems. Few applications in GIS and robot motion planning, and physical design in VLSI.

Textbooks / References:

1. Computational Geometry: Algorithms and Applications (2nd Edition), M. de Berg, M. van Kreveld, M. Overmars, O. Schwarzkopf, Springer-Verlag, 2000.
2. Computational Geometry, F. Preparata and M. Shamos, Springer-Verlag, 1985
3. Computational Geometry: An Introduction Trough Randomized Algorithms, K. Mulmuley, , Prentice-Hall, 1994
4. Discrete and Computational Geometry, S. L. Devadoss and J. O'Rourke, 2011
5. Computational Geometry Lecture Notes, David M. Mount, Department of Computer Science, University of Maryland, Fall 2002

Professional Elective IV

CSEN5241 – CSEN5245	Professional Elective IV
CSEN5241	Human and Computer Interaction
CSEN5242	Graph Algorithms
CSEN5243	Cloud Computing
CSEN5244	Algorithms for VLSI CAD
CSEN5245	Spatial Informatics and GIS

Subject Name: Human and Computer Interaction					
Paper Code: CSEN5241					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
After completion of course, students would be able to:
1. Understand the structure of models and theories of human computer interaction.
2. Identify basic concepts, terminology, theories, models and methods in the field of Human Computer Interaction
3. Understand basics of interactive designing, how to prototype, iterate and refine based on the standard principles and guidelines.
4. Understand the socio organizational issues in cognitive models. Be able to identify the key players and their requirements.
5. Understand how users interact with mobile apps and widgets and design such mobile ecosystems.
6. Design an interactive web interface based on the different models studied.

Module I (7L):
Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.
Module II (11L):
Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.
Module III (7L):
Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW. 8L
Module IV (11L):
Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design
Designing Web Interfaces – Drag and Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow.

References:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004 (UNIT I , II and III)
2. Brian Fling, "Mobile Design and Development", First Edition ,OReilly Media Inc., 2009 (UNIT – IV)
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, OReilly, 2009.(UNIT-V

Course Name: Graph Algorithms					
Course Code : CSEN5242					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Learning Objective: The main objective of the course is for students to learn some classical theorems and algorithms in this domain. It is expected that students will be able to demonstrate their knowledge of algorithms by solving concrete problems. In addition, students will be able to prove some simple facts and theorems about graphs and graph algorithms.

Course Outcomes:
Students who complete the course will demonstrate the ability to do the followings.

1. Learn the advanced concepts and key features of Graph algorithms.
2. Understand the algorithmic approach to Graph related problems.
3. Explain and analyze the major graph algorithms.
4. Employ graphs to model engineering problems, when appropriate.
5. Defend and argue the application of the specific algorithm to solve a given problem.
6. Synthesize new algorithms that employ graph computations as key components, and analyze them.
7. Hypothesize for a critical problem, where graph is involved as an absolutely necessary component.

Module I:
Connected components and transportation related graph problems

- Representation of graphs, Sub graphs, Degree Sequences, Connectivity, Cut-Vertices and Bridges, Digraphs. [1L]
- Depth First Search. DFS for undirected graphs, non-separable components and directed graphs. Topological Sorting. Strongly connected components, Tarjan's algorithm for strongly connected components. [2L]
- Eulerian tours, Characterization. De Bruijn Sequences. Eulerian Digraphs. [2L]
- Hamiltonian graphs and travelling salesman problem. Exponential-time dynamic programming for the TSP, approximation algorithms and the approximation ratio, MST-doubling heuristic, Christofides' heuristic. [4L]

Module II:
Flow networks and Bipartite graphs

- Max flow min cut theorem, max flow algorithms and their applications. [2L]
- Min cost max flow algorithm, their applications. [2L]
- Bipartite graphs, formulating bipartite maximum matching as a flow problem. [1L]

Matching and covering related graph problems

- Matchings, stable marriage problem, Gale-Shapley algorithm for stable marriage problem. [2L]
- Hopcroft–Karp algorithm. Using matchings to find vertex covers and independent sets. [2L]

Module III:
Graph Coloring, Planarity and longest path

- Graph coloring, greedy coloring, Maximal clique [2L]
- Brooks theorem, the greedy algorithm, the Welsh-Powell bound, critical graphs, chromatic polynomials, girth and chromatic number, Vizing's theorem. [2L]
- Introduction to planarity of the graph, duality of the planar graph and max cut of the planar graph. Euler's formula, Kuratowski's theorem, toroidal graphs, 2-cell embeddings, graphs on other surfaces. [4L]
- Longest path Problem, hardness and heuristic for solution. [1L]

Module IV:
Random graphs and Selected topics

- Random graphs and probabilistic methods. [2L]

Course Name: Cloud Computing					
Course Code : CSEN5243					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

COURSE OUTCOMES

Students who complete the course will demonstrate the ability to do the followings.

1. Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud.
2. Describe the core issues of cloud computing such as security, privacy, and interoperability to choose the appropriate technologies, algorithms, and approaches for the identified problems.
3. Analyze various cloud computing solutions.
4. Evaluate cloud Storage systems and Cloud security, the risks involved, its impact.
5. Apply knowledge for solving real life cloud computing problem scenario and illustrate solutions.
6. Develop appropriate cloud computing solutions and recommendations according to the applications used.

Module-1: [9L]

a. Basics of Cloud Computing [5L]:

- Defining a Cloud, Cloud Types – NIST Cloud Reference Model, Cloud Cube Model, Deployment Models (Public, Private, Hybrid and Community Clouds), Service Models – Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS)
- Characteristics of Cloud Computing – a shift in paradigm
- Benefits and Advantages of Cloud Computing

b. Concepts of Abstraction and Virtualization [4L]:

- Virtualization: Taxonomy of Virtualization Techniques
- Hypervisors: Machine Reference Model for Virtualization

Module-2: [9L]

a. Services and Applications by Type [6L]:

- IaaS – Basic Concept, Workload, Partitioning of Virtual Private Server Instances, Pods, Aggregations, Silos
- PaaS – Basic Concept, Tools and Development Environment with examples
- SaaS - Basic Concept and Characteristics, Open SaaS, examples of SaaS Platform
- Identity as a Service (IDaaS)
- Compliance as a Service (CaaS)

b. Concepts of Service Oriented Architecture (SOA) and Web Service (WS) [3L]:

- Service Oriented Architecture – Basics, Terminologies, Components, Standards and Technologies, Benefits and Challenges
- Web Services – Basics, Characteristics, Terminologies, Characteristics and Scope, Business Models

Module-3: [9L]

a. Cloud-based Storage [4L]:

- Cloud File Systems, including GFS and HDFS

b. Cloud Security [2L]:

- Cloud security concerns, security boundary, security service boundary
- Overview of security mapping
- Security of data: cloud storage access, storage location, tenancy, encryption, auditing, compliance
- Identity management (awareness of identity protocol standards)
- Risk Management and Compliance

c. Cloud Management [3L]:

- An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, monitoring of an entire cloud computing deployment stack – an overview with mention of some products
- Lifecycle management of cloud services (six stages of lifecycle)
- Cloud service QoSs and maintenance

Subject Name: Algorithms for VLSI CAD					
Paper Code: CSEN5244					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

COURSE OUTCOMES

Students who complete the course will demonstrate the ability to do the followings.

1. Understand physical design automation, optimization techniques and data structures inside modern VLSI tools.
2. Understand how to decompose large mapping problem into pieces, including logic optimization with partitioning, placement and routing.
3. Know how to place the blocks and how to partition the blocks while for designing the layout for IC.
4. Solve the performance issues in circuit layout.
5. Analyze physical design problems and Employ appropriate automation algorithms for partitioning, floor planning, placement and routing.
6. Evaluate circuits using both analytical and CAD tools.

Module I: (10L)

Preliminaries (Data Structures and Basic Algorithms)

Data structures for Representation of Graphs, Breadth First Search, Depth First Search, Topological Sort, Spanning Tree Algorithm - Kruskal‟s and Prim‟s, Shortest path Algorithm - Dijkstra‟s Algorithm for single pair Shortest path, Floyd-Warshall algorithm for All pair Shortest path, Min cut and Max cut Algorithms

Model II: (8L)

Partitioning: Simulated Annealing, Kernighan-Lin Partitioning Algorithm, FiducciaMattheyses Algorithm. (3L)

Floor planning and Pin Assignment: Introduction, Problem Definition, Approaches to Floor planning (timing driven, Simulated Evolution, Hierarchical Tree Based, Pin assignment, Chanel assignment), Other Approaches and Recent Work. (5L)

ModuleIII: (8L)

Placement

Circuit Representation, Wire-length Estimation, Types of Placement Problem, Placement Algorithms – Constructive Placement, Iterative Improvement, Simulation Based Placement Algorithms, Partitioning Based Placement Algorithms, Other Placement Algorithms like cluster growth, Branch-and-Bound Technique

Module IV: (10L)

Global Routing

Problem Formulation, Classification of Global Routing Algorithms, Maze Routing Algorithm – Lee's Algorithm, Line-Probe algorithm, Steiner Tree based Algorithm. (5L)

Detailed Routing: Area Routing, Channel Routing – Channel Routing Model, Vertical and Horizontal Constraint Graph, Left edge Algorithm, Robust Channel Routing Algorithm (5L)

References:

1. N. Sherwani, Algorithms for VLSI Physical Design Automation, Third Edition, Kluwer, 1998
2. S. M. Sait and H. Yousuf, Iterative Computer Algorithm with Applications in Engineering, Wiley/IEEE, 2002

Subject Name: Spatial Informatics and GIS					
Paper Code: CSEN5245					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Learning Objective
The objective of this course is enhancing students' understanding of the physical world, knowing and communicating their relation to places in that world, and navigating through those places. Students will learn how to collect, analyze, and visualize large-scale spatial datasets while avoiding common pitfalls and building better data-intensive applications and location-aware technologies. Students will also gain a deep understanding about the fundamental research questions in individual disciplines and cross-cutting research questions requiring novel, multi-disciplinary solutions.

Course Outcomes:
Students who complete the course will demonstrate the ability to do the followings.
1. Learn the relevant Geographic Information Systems and techniques for working with geospatial data.
2. Understand how Semantic Web technology fits into the present and future evolution of GIS, and how it differs from existing data-sharing technologies, such as relational databases and the current state of the World Wide Web.
3. Explain use of Geospatial libraries to solve real-world problems with greater flexibility.
4. Employ Volunteered Geographic Information and understand how it relates to Big Geospatial Data and GIS design.
5. Recognize methods to geocode text data.
6. Synthesize and hypothesize relevant Spatial Informatics techniques to solve a variety of spatial problems.

Module 1 (9L)
Introduction and Overview of Geographic Information Systems. (4L)
Definition of a GIS, features and functions; why GIS is important; how GIS is applied; GIS as an Information System; GIS and cartography; contributing and allied disciplines; GIS data feeds; historical development of GIS.
GIS and Maps, Map Projections and Coordinate Systems (5L)
Maps and their characteristics (selection, abstraction, scale, etc.); automated cartography versus GIS; map projections; coordinate systems; precision and error.

Module 2 (9L)
Data Sources, Data Input , Data Quality and Database Concepts (5L)
Major data feeds to GIS and their characteristics: maps, GPS, images, databases, commercial data; locating and evaluating data; data formats; data quality; metadata. Database concepts and components; flat files; relational database systems; data modeling; views of the database; normalization; databases and GIS.
Spatial Analysis (4L)
Questions a GIS can answer; GIS analytical functions; vector analysis including topological overlay; raster analysis; statistics; integrated spatial analysis.

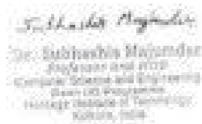
Module 3 (9L)
Making Maps (5L)
Parts of a map; map functions in GIS; map design and map elements; choosing a map type; producing a map formats, plotters and media; online and CD-ROM distribution; interactive maps and the Web.
Implementing a GIS (4L)
Planning a GIS; requirements; pilot projects; case studies; data management; personnel and skill sets; costs and benefits; selecting a GIS package; professional GIS packages; desktop GIS; embedded GIS; public domain and low-cost packages.

Term Paper and Seminar -CSEN5293

The students should be able to communicate effectively with confidence on the Subject Topics .

They should be able to learn important concepts related to Technical Skills required in the industry ,within the specified time.

It also gives an exposure to the latest research domains that they are going to explore in depth during their final year projects.



Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Detailed Syllabus
M. Tech. in Applied Electronics and Instrumentation Engineering (AEIE)
1st Year –2nd Semester

Subject Name: EMBEDDED SYSTEMS					
Paper Code : AEIE 5201					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [9L] ***Introduction to an Embedded System:*** Embedded systems overview, design challenge, processor technology, IC technology, Design Technology, Trade-offs. Processors - Application Specific Instruction-Set Processors (ASIPs)
Micro Controllers and Digital Signal Processors, Special Purpose Processors, I/O devices.

Module II - [10L] ***Introduction to AVR microcontroller:*** Introduction to AVR (ATmega 328p-pu) microcontroller, pin layout, architecture, program memory, Data Direction register (DDRx), Port Registers (PORTx), PWM registers (8-bit), ADC registers, basics of communication, overview and interfacing I/O devices with I^2C Bus, UART and Serial Peripheral Interchange (SPI) bus, introduction to AVR Studio and avrdude with GNU gcctoochain.

Module III - [9L] ***Embedded Systems Software:*** Introduction to Linux based operating systems and Linux commands (i.e. GNU bash), introduction to Embedded Linux (i.e. Arch and Debian) Real-time operatingsystems, introduction to Python 2.7 on Raspberry Pi

Module IV - [8L] ***Programming Embedded Systems with AVR (Arduino API), ARM CPUs and case studies:*** Introduction to ARMv8-A based embedded development board (i.e. Raspberry Pi rev.3), programming a Raspberry Pi rev.3 using Python 2.7, introduction to Arduino UNO rev.3, case study- user defined LED blink using Raspberry Pi GPIOs, communication between an Arduino UNO rev.3 with Raspberry Pi 3 over USB serial.

References:

1. Elliot Williams, *AVR Programming: Learning to Write Software for Hardware*, Maker Media, Incorporated, 2014
2. Silberschatz Galvin Gagne, *Operating System Concepts*, WILEY, 2014
3. Raj kamal, *Embedded Systems: Architecture, programming and design*, TMH, 2002.
4. David E. Simon, *An Embedded Software Primer* , Pearson Ed., 2005.
5. Arnold S Burger, *Embedded system design*, CMP.

-71

6. KVKK Prasad, *Embedded / Real Time Systems*, Dreamtech Press, 2005.
7. Kraig Mitzner, *Complete PCB Design using ORCAD Capture and Layout*, Elsevier.
8. Woon-Seng Gan and Sen M. Kuo, *Embedded Signal Processing with the Micro Signal Architecture*, John Wiley & Sons, Inc., Hoboken, New Jersey 2007.
9. Dhananjay Gadre, *Programming and Customizing the AVR Microcontroller*, McGraw Hill Education, 2014.

Course Outcome:

After the completion of the course students will be able to:

1. Gain the knowledge in the area of embedded development of AVR microcontroller.
2. Justify the selection criteria for ARM based single board computers for needs in industrial environment.
3. Demonstrate working knowledge of programming Linux based systems used in industry applications.
4. Design embedded systems required in industry applications.
5. Write programs for embedded systems using Python.
6. Learn techniques to develop applications using SPI/I2C bus.

Chaty

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: MICRO SENSOR SCIENCE AND TECHNOLOGY					
Paper Code: AEIE5231					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [10L]

Overview of Micro-Sensors Engineering Science for Design and Fabrication:
Principle of transduction; classification of micro-sensors; Chemical, thermal, pressure, acoustic, optical, electrical, mechanical and biological sensors- their calibration and determination of characteristics. Atomic structure of matter, Ions and ionization; Molecular theory of matter and intermolecular forces; Doping techniques of semiconductor; The diffusion process; Plasma Physics; ElectroChemistry: electrolysis, electrodynamics.

Module II - [11L]

Micro-Fabrication Process:
IC technology used in micro sensor system; Crystal growth and wafer making, different techniques of deposition; physical vapor deposition - evaporation, thermal oxidation, sputtering, epitaxy, ion implantation and diffusion, Chemical vapor deposition- LPCVD, APCVD, PECVD, spin coating, electrochemical deposition.
Pattern generation and transfer- masking, photolithography: Photoresists and application, light sources, photo resist development and removal; different types of etching: chemical and plasma.

Module III - [8L]

Materials for Micro-Sensors:
Substrates and Wafers; Silicon as substrate material; Silicon Compounds: Silicon dioxide, Silicon Carbide, Silicon Nitride and Polycystalline silicon, Silicon Piezo-resistors, Gallium Arsenide, Quartz, Piezoelectric crystals, Polymers, Langaur-Blodgett (LB) films, Packaging materials.

Module IV - [7L]

Micro-manufacturing techniques & Introduction to Smart Sensors:
Overview of micro-manufacturing techniques: Bulk Micro-machining, Surface Micro-machining, LIGA. Examples of selected micro sensors. Introduction; Nature of semiconductor sensor output, information coding, integrated sensor principles, sensor networking, present trends.

References:

1. J. W Gardner, V. K. Varadan, *Microsensors, MEMS and Smart Devices*, Wiley, 2001.

2. Stephen Beedy, *MEMS Mechanical Sensors*, Artech House, 2004.
3. N. P. Mahalik, *MEMS*, McGraw Hill, 2007.
4. Jon Wilson, *Sensor Technology Handbook*, Elseiver, 2005.
5. Leondes, Cornelius T. (Ed.), *Mems/Nems Handbook Techniques and Applications*, Springer, 2006.
6. Mohamed Gad-el-Hak, *The MEMS Handbook*, CRC Press; 2nd edition, 2005.
7. B. G. Streetman and Sanjay Banerjee, *Solid State Electronic Devices*, Prentice Hall; 6th edition, 2005.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Gain the concept of transduction principle in micro-sensors.
2. Understand the atomic structure of matter, dopinig process, ionization process and diffusion in semiconductor.
3. Learn the process microfabrication technology.
4. Identify the pattern generation and transfer process like masking, photolithography, etc.
5. Learn different types of materials used in microsensor fabrication.
6. Understand various types of micro-manufacturing techniques and concept of smart sensors.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

SUBJECT NAME: ADVANCED POWER ELECTRONICS					
Paper Code: AEIE5232					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [9L]
Classification of Electric Drives, Requirements of Electric Drives, Some Applications -

Three-phase converters, effect of load and source impedances; multi-pulse converters, transformer utilization; Multi-pulse converters using delta/ zigzag/ Polygon transformers.

DC-DC converters-Cuk converter

Module II - [9L]

Review of Three-phase voltage source inverters & Current source inverters, voltage and frequency control, transient voltage suppressing techniques

Harmonic reduction techniques, PWM inverters, Space Vector Modulation.

Multi-level inverters, advantages, configurations: Diode clamped, flying capacitor and cascade multi-level inverters.

Module III-[10L]
Speed-torque characteristics DC shunt, PMDC and series motors, Dynamic model, Speed and position control methods.

d-q model of induction motor, constant flux speed control structure, vector control model, vector control structure.

Module IV-[8L]
Evolution of HVDC Transmission, Comparison of HVAC and HVDC systems, Type of HVDC Transmission systems, Components of HVDC transmission systems, HVDC control Modes, Schemes and relative comparisons, Reactive power measurements, Converter protection.

References:

1. N. Mohan, T. M. Underland and W.P. Robbins, *Power Electronics – Converters, Applications and Design*, 3rd Ed., Wiley, India, 2008.
2. S. N Singh, *Electric Power Generation, Transmission and Distribution*, PHI, New Delhi 2nd edition, 2008.
3. B. N. Sarkar, *Fundamentals of Industrial Drives*, PHI, 2011.
4. Teresa Orlowska-Kowalska, Frede Blaabjerg, José Rodriguez, *Advanced and Intelligent Control in Power Electronics and Drives*, Springer International Publishing, 2014

Course Outcome:
After the completion of the course, the students will be able to:

1. Describe DC Drive operations and implementations
2. Compare between performance of Voltage source and current source inverters

3. Differentiate among multi-level inverters.
4. Analyze speed and position control methods of DC motors
5. Explain control of induction motors
6. Explain control mechanisms and models of HVDC and HVAC Transmission lines

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

	SUBJECT NAME: DIGITAL IMAGE PROCESSING				
	Paper Code: AEIE5241				
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [10L]

Introduction to Digital Image Processing & Image Transforms:
Digital image and video fundamentals and formats, 2-D and 3-D sampling and aliasing, 2-D/3-D filtering, image decimation/interpolation, video sampling and interpolation, Basic image processing operations; Color image fundamentals - Colour models, Conversion of colour models, Pseudo colour image processing, Full colour processing; Image Transforms-Need for image transforms, DFT, DCT, Hadamard, Haar and Wavelet transforms.

Module II - [10L]

Image Enhancement and Restoration and Morphological Image Processing:
Basic gray level transformations, histogram processing, Smoothing and sharpening spatial filters, Image enhancement in frequency domain, Smoothing and sharpening frequency domain filters, Image restoration, Types of noises, noise reduction by spatial and frequency domain filtering, Homomorphic filtering. Image Restoration - degradation model, Unconstrained and Constrained restoration, Inverse filtering - removal of blur caused by uniform linear motion, Wiener filtering. Morphological operations- Dilation and Erosion, Opening and Closing, Boundary extraction.

Module III - [8L]

Image Compression:
Need for data compression, Coding redundancy, Interpixel redundancy, Psycho visual redundancy, Image compression models, Error free compression, Huffman coding, Run Length coding, Shift coding, Arithmetic coding, Vector Quantization, Block truncation coding, Lossless predictive coding, Lossy predictive coding, Transform coding, Wavelet coding.

Module IV - [8L]

Image Segmentation, Representation, Description and Recognition:
Discontinuity based segmentation- Line detection, edge detection, thresholding techniques, Region based segmentation, boundary descriptors; Image Recognition - Patterns and pattern classes, Feature extraction, feature selection techniques, Introduction to classification-supervised and unsupervised learning, Template matching, Bayes classifier, Cluster analysis-k-means method.

References:

1. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, 3rd Edition, Prentice Hall, 2008.

2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall of India, 2002.
3. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, *Digital Image Processing using MATLAB*, Pearson Education, Inc., 2004.
4. William K. Pratt, *Digital Image Processing*, John Wiley, NewYork, 2002.
5. Milman Sonka, Vaclav Hlavac, Roger Boyle, *Image Processing, Analysis and Machine Vision*, Brooks/Cole, Vikas Publishing House, II ed., 1999.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Learn how images are formed, sampled, quantized and represented digitally and processed by discrete, linear, time-invariant systems.
2. Apply transformation algorithms such as DFT, DCT, Walsh, Hadamard, Haar, KLT and Wavelet transform to any given image.
3. Perform image enhancement, restoration and morphological operations on images.
4. Compress a given image by applying lossy and loss less image coding techniques.
5. Learn segmentation of a given image by line, edge and boundary detection and thresholding and region based techniques.
6. Gain concept of analyzing an imege by features extraction and object recognition techniques.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: STATISTICAL AND BIO-SIGNAL PROCESSING					
Paper Code: AEIE5242					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [10L]

Introduction:

Concepts of Biostatistics. Basic statistical measures, measures of central tendency, measures of dispersion, variance, standard deviation, Analysis of variance. Hypotheses testing: The null and alternative hypothesis, Types of tests: t-test, f-test etc.
Biomedical signals – ECG,EEG, EMG etc., Stochastic and deterministic signals, concepts of stationary and periodicity. Discrete signals, the sampling theorem, Aliasing. Quantization error. Duality of time and frequency domain.

Module II - [8L]

Regression and correlation:

Simple linear regression model, regression equation. Multiple regression and correlation model. Filtering Random Process, Special Types of Random Process- ARMV Process, AR Process, MA Process, Harmonic Process, prediction and probability of occurrence.

Module III - [10L]

Univariate signal:

Filters, Matched filters; Wiener filters Probabilistic models; Hidden Markov model; Kalman filter.

Multivariate signals:

Multivariate autoregressive model (MVAR); Formulation of MVAR model4; Formulation of MVAR model.

Module IV - [8L]

Case study-I: Application to biomedical signals:

Analysis of continuous EEG signals, Single channel analysis; Multiple channel analysis: Mapping; Elimination of artifacts; sleep EEG analysis.

Case study-II: Application to biomedical signals:

Analysis of continuous ECG signals: Measurements, Processing of ECG, Artifact removal, Statistical methods and models for ECG; Heart rate variability: Time-domain methods of HRV analysis; Frequency-domain methods of HRV analysis.

References:

1. Stanton A. Glantz, *Primer of Biostatistics*, McGraw Hill, 2nd Ed.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

2. A.K. Sharma, *Text Book of Biostatistics*, DPH Mathematics series,2005
3. Monson H. Hayes, *Statistical Digital Signal Processing & Modeling*, John Wiley & Sons.
4. Dimitris G. Manolakis, Vinay K. Ingle, Stephen M. Kogon, *Statistical and Adaptive Signal Processing*, ARTECH HOUSE, INC., Norwood, 2005.
5. D.C. Reddy, *Biomedical Signal Processing: Principles and techniques*, TMH, NewDelhi,2005
6. Semmlow, *Biosignal and Biomedical Image Processing*, Marcel Dekker, 2004.
7. Bruce, *Biomedical Signal Processing*, Prentice Hall, 1993.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Compute statistical measures such as central tendency, dispersion, variance, standard deviation of a signal.
2. Describe and apply various Hypotheses testing techniques.
3. Stochastic and deterministic analysis of ECG, EEG, and EMG signals.
4. Learn regression and correlation models and different random process such as –ARMV Process, AR Process, MA Process, Harmonic Process, etc.
5. Apply matched filter; Wiener and Kalman filter on bio-signals and develop probabilistic models, Hidden Markov models and multivariate autoregressive model (MVAR), etc.
6. Learn practical usage of ECG and EEG signal processing techniques.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: INDUSTRIAL INTERNET OF THINGS					
Paper Code: AEIE5243					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [9L]

IoT & Web Technology: The Internet of Things Today, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recent trends in home automation: IOT-locks, Energy optimization in home.

Module II - [9L]

Development of sensor communication protocols, Protocols: Modbus, relay, Zigbee, Zwave, X10, Bluetooth, ANT, etc. Zigbee and Zwave — advantage of low power mesh networking. Long distance Zigbee. Introduction to different Zigbee chips. Bluetooth/BLE: Low power vs high power, speed of detection, class of BLE. Wireless protocols such as Piconet and packet structure for BLE and Zigbee.

Module III - [9L]

PCB vs FPGA vs ASIC design, Prototyping electronics vs Production electronics, QA certificate for IoT- CE/CSA/UL/IEC/RoHS/IP65, Basic Open source platforms: Arduino, Raspberry Pi, Beaglebone. M2M to IoT – A Basic Perspective– Introduction, An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module IV - [9L]

Available M2M cloud platform, Axeda Xively, Omega NovoTech, Ayla Libellium, CISCO M2M platform, AT &T M2M platform, Google M2M platform, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, IoT for Retailing Industry, IoT For Oil and Gas Industry.

References:

1. Vijay Madisetti and ArshdeepBahga, *Internet of Things (A Hands-on-Approach)*, 1st Edition, VPT, 2014.
2. Francis daCosta, *Rethinking the Internet of Things: A Scalable Approach to Connecting Everything*, 1st Edition, Apress Publications, 2013.

3. Olivier Hersent, David Boswarthick, Omar Elloumi, *The Internet of Things: Key Applications and Protocols*, Wiley-Blackwell.
4. Cuno Pfister, *Getting Started with the Internet of Things*, O_Reilly Media, 2011.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Determine the IIoT architecture and application in various fields.
2. Distinguish building blocks of Internet of Things and characteristics.
3. Outline the concept of NB-IoT and LoRa.
4. Realize the importance of security and privacy issues in IIoT.
5. Interprete the concept of IIoT and M2M.
6. Point out the applications of IIoT in various industries.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: EMBEDDED SYSTEMS LAB					
Paper Code : AEIE 5251					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	4	4	2

1. Introduction to Atmel Studio 7.0 and Arduino IDE basics
2. Experiments with GPIO devices in Atmega 328p-pu (AVR):
   a) Input: Push Button using external and internal pull up.
   b) Output: Light LEDs, Flash LEDs (Delay Loop), Simple Delays Using Timer0, Rotate LEDs.
3. Programming with Timers to control servo position in an Atmega 328p-pu (AVR).
4. Experiments with Atmega 328p-pu (AVR) ADC: LDR based intensity measurement.
5. Interfacing MPU 6050 accelerometer using Arduino UNO.
6. Speed control of DC motor using PWM in Arduino UNO.
7. Programming Raspberry Pi 3 GPIOs using Python 2.7.
8. Programming UART application in Arduino UNO.
9. Interfacing Arduino UNO with Raspberry Pi 3 over USB serial.

Course Outcome:

After the completion of the course students will be able to:
1. Design and conduct experiments with input and output devices using an AVR microcontroller.
2. Perform programming with PORT, ADC and I2C bus registers in an AVR microcontroller.
3. Interface a sensor with and AVR microcontroller and monitor its input by displaying the measured value in a PC.
4. Implement USB communication between a Raspberry Pi and Arduino.
5. Perform interfacing with GPIO of Raspberry Pi.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: PROCESS CONTROL SYSTEM DESIGN LAB					
Paper Code : AEIE 5252					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	4	4	2

1. Study of boiler drum and burner management system using Boiler SIM software.
2. P, PI, PID controller tuning for different simulation processes.
3. Real time DC motor speed control and furnace temperature control using PI/PD/PID controller.
4. Study the system modeling techniques using Model identification Toolbox.
5. Design of adaptive controller – model reference adaptive controller (MRAC), self-tuning regulator (STR).
6. Dual control scheme for crane position and swing angle control of a digital pendulum.

Course Outcome:

After the completion of the course, the students will be able to:

1. Understand the activity and importance of boiler drum in an industry.
2. Perform tuning of different conventional controllers.
3. Control different processes by designing controllers in simulation and real time environment.
4. Design different adaptive schemes for effective control.
5. Apply dual control scheme for crane position and angle control.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: TERM PAPER AND SEMINAR					
Paper Code: AEIE5293					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	4	4	2

The students are required to search/gather the material/information on a specific topic, comprehend it and present/discuss in the class. The paper topic should be relevant with Instrumentation engineering and related areas of technology. The topic should be decided by the student and concerned teacher. Seminar work shall be in the form of presentation to be delivered by the student regularly throughout the semester. The students should submit a report consist of a preliminary outline of paper, a list of the references that they have reviewed to date, a short statement of the findings of the paper and analysis of how this information fits, or does not fit, into the paper. The candidate will deliver a final talk on the topic at the end of the semester and assessment will be made by a group of internal examiners.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Understand of contemporary/emerging technology for various processes and systems.
2. Learn how to write a technical document.
3. Demonstrate the ability to deliver technical seminar.
4. Interact effectively with audience to share knowledge and views.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: ADVANCED DIGITAL SIGNALS AND SYSTEMS					
Paper Code: AEIE5101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [9L]

Discrete-Time Signals, Systems and Transforms:
Overview of DSP, Characterization of discrete time signals and systems, Sampling and, aliasing, Quantization error; Convolution and correlation, DFT and IDFT, FFT Algorithms, Introduction to - time frequency analysis, Short Time Fourier Transform, Continuous Wavelet Transform (CWT), and Discrete Wavelet Transform (DWT), Application of Wavelet Transform.

Module II - [9L]

Digital Filter Design Techniques and Structures:
Digital filter design and structures: Basic FIR/IIR filter design & structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR direct form-I and II, cascaded, parallel and lattice structures realization.

Module III-[9L]

Multirate Signal Processing and Adaptive Filtering:
Introduction to change of sampling rate – Decimation and Interpolation- Direct digital domain approach - Decimation by integer factor - Interpolation by an integer factor - Single and multistage realization - Poly phase realization – Applications of Multirate signal Processing - Subband coding and filter banks.
Adaptive Filters- Principles of adaptive filtering, LMS and RLS algorithms, Applications in noise and echo cancellation.

Module IV- [9L]

Linear Prediction, Optimum Linear Filters and Power Spectral Estimation:
Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.
Estimation of Spectra from finite-duration observations of signals, Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

References:

1. John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, 4th ed, Prentice Hall, 2007.
2. Sanjit K. Mitra, *Digital Signal Processing- A computer based Approach*, McGraw-Hill.
3. Monson H. Hayes, *Statistical Digital Signal Processing & Modeling*, John Wiley & Sons, 2002.
4. P. P. Vaidyanathan, *Multirate Systems and Filter Banks*, Prentice Hall, 1992.
5. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, *Digital Signal Processing*, TMH, 2nd Edition, 2010.
6. S. Haykin, *Adaptive Filter Theory*, 4th Edition, Prentice Hall, 2001.
7. D. G. Manolakis, V. K. Ingle and S. M. Kogon, *Statistical and Adaptive Signal Processing*, McGraw Hill, 2000
8. A.V. Oppenheim, R.W. Schaffer and John R. Buck, *Discrete Time Signal Processing*, 3rd Edition, Prentice-Hall Signal Processing Series, 2009.
9. A. Nagoor Kani, *Signals and Systems,* McGraw Hill Education (India) Privet Limited, New Delhi, 2013.

Course Outcome:

After the completion of the course, the students will be able to:

1. Characterize and analyze the properties of discrete time signals and systems.
2. Perform DFT, FFT and IDFT of a given discrete signal and learn STFT and DWT of discrete signal.
3. Design digital FIR and IIR filters according to the given specification.
4. Realize a digital filter structure from it's transfer function.
5. Understand theory of multirate DSP and adaptive filtering techniques, solve numerical problems.
6. Understand theory of prediction, solution of normal equations and methods of spectral estimation.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: PROGRAMMING LANGUAGE FOR EMBEDDED IOT SYSTEMS					
Paper Code: AEIE 5102					
Contact hours per week:	L	T	P	Total	Credit points
	3	0	0	0	3

***Module I* [10L]-**

Introduction to IoT:

IoT-An Architectural Overview, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals-Devices and gateways, Local and wide area networking, Data management, Everything as a Service (XaaS), M2M and IoT analytics.

***Module II* [9L]**

Languages for IoT:

Introduction to Python 2.7 - I/O statements, condition statements, loops, functions, classes, Python packages (i.e. serial, os, JSON, urllib, httplib), publishing messages to the cloud using PubNub, MQTT broker with python client, Introduction Android Things on Raspberry Pi 3 using Java/Kotlin.

***Module III*-[9L]**

Introduction to Cloud:

Introduction to Cloud Computing, Platform for Internet of Things and Analytics using ThingSpeak and PubNub, Real time sensor (i.e. LM35, DHT 11, MQx gas sensors) data acquisition using NodeMCU and ESP8266 for Arduino, Introduction to Python for microcontrollers.

***Module IV*-[8L]**

Cloud services for IoT:

Development environments for cloud services; AWS IoT, Google App-cloud platform in for industrial IoT, Introduction to Android Studio for Android Things App development. Understanding the relationship between IoT and BigData, IoT data analytics on cloud.

References:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, *From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence*, 1st Edition, Academic Press, 2014.
2. Gaston C. Hillar, *Internet of Things with Python*, 1st Ed. Packet Publishing, 2016.
3. Peter Waher, *Learning Internet of Things*, PACKT publishing, BIRMINGHAM – MUMBAI
4. Bernd Scholz-Reiter, Florian Michahelles, *Architecting the Internet of Things*, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
5. Daniel Minoli, *Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications*, ISBN: 978-1-118-47347-4, Willy Publications.
6. Vijay Madisetti and ArshdeepBahga, *Internet of Things (A Hands-on-Approach)*, 1st Edition, VPT, 2014.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Outcome:

After the completion of the course, the students will be able to:

1. Interpret the vision of IoT from a global context.
2. Understand the key features, design challenges and related to IoT systems.
3. Learn the architecture of NodeMCU and develop IoT systems using it.
4. Demonstrate working knowledge of Micro Python.
5. Design an IoT system with functional requirements for hardware components including processor, networking components and sensors.
6. Develop an IoT system with along with applications of cloud.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: RESEARCH METHODOLOGY AND IPR					
Paper Code: AEIE5103					
Contact hrs per week:	L	T	P	Total	Credit points
	2	0	0	2	2

Module I – [6L]

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation.

Module II - [6L]

Effective literature studies approaches, analysis Plagiarism, Research ethics.
Effective technical writing, how to write report, Paper developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Module III-[6L]

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Module IV- [6L]

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. C. R. Kothari, *Research Methodology- Methods and Techniques*, 2nd ed., New Age International Publishers, 2004.
2. Stuart Melville and Wayne Goddard, *Research methodology: an introduction for science & engineering students.*
3. Wayne Goddard and Stuart Melville, *Research Methodology: An Introduction.*
4. Ranjit Kumar, 2nd Edition, *Research Methodology: A Step by Step Guide for beginners.*
5. Halbert, *Resisting Intellectual Property*, Taylor & Francis Ltd., 2007.
6. Mayall, *Industrial Design*, McGraw Hill, 1992.
7. Niebel, *Product Design*, McGraw Hill, 1974.

8. Asimov, *Introduction to Design*, Prentice Hall, 1962.
9. Robert P. Merges, Peter S. Menell, Mark A. Lemley, *Intellectual Property in New Technological Age*, 2016.
10. T. Ramappa, *Intellectual Property Rights Under WTO*, S. Chand, 2008.

Course Outcome:

After the completion of the course, the students will be able to:

1. Understand research problem formulation and its solution approches.
2. Analyze research related information.
3. Learn how to write report and research proposal following research ethics.
4. Judge importance of intellectual property and patent rights and learn the process of obtaining them.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

SUBJECT NAME: MICRO-ELECTRONIC DEVICES AND CIRCUITS					
Paper Code: AEIE5131					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [10L]
Introduction to Microelectronics: IC Production Process- Basic Steps involved in Production, Layout and Fabrication.
Analog Building Blocks: Active resistors, Current mirrors/amplifiers, Current sources and sinks, Voltage and Current references.
Digital Building Blocks: NMOS inverter and CMOS inverter.

Module II - [9L]
Analysis of Analog Integrated Circuits: DC analysis and small signal (ac) analysis of 741 Op-amp: Input stage, intermediate (second) stage and output stage – Gain, input-output resistance and frequency response. Analysis of two stage CMOS amplifier, IC-power amplifier

Module III-[9L]
Digital Integrated Circuits Analysis: Performance analysis of CMOS inverter, CMOS logic Circuits; Pass-transistor Circuits; Dynamic Logic Circuits.

Module IV-[8L]
Design of Analog Integrated Circuits: ADC, DAC, Trans-conductance and Trans-resistance amplifier. Design of Digital Integrated Circuits: Flip-flops and multivibrator circuits; Dynamic MOS Storage Circuit; (Fussable) Logic gate array.

References:

1. Sedra Smith, *Microelectronic Circuits*, 5th Edition, McGraw Hill.
2. R. L. Geiger, P. E. Allen & N. R. Strader, *Design techniques for Analog & Digital Circuits*, McGraw Hill, Singapore, 1990.
3. D. A. Hodges & H. G. Jackson, *Analysis and Design of Digital Integrated Circuits*, McGraw Hill, New York, 1983.
4. S. M. Sze, *VLSI Technology*, Second Edition, TMH, New Delhi, 2004.
5. C. G. Fonstad, *Microelectronic Devices and Circuits*, Electronic Edition, 2006.

Course Outcome:
After the completion of the course, the students will be able to:

1. Explain the production and fabrication process of microelectronic devices and integrated circuits.
2. Select MOS transistor as per datasheet parameters to design analog and digital building blocks.
3. Analyze the DC and AC performance of single-stage analog amplifiers.
4. Analyze analog electronic circuits of moderate complexity.
5. Explain the operation and features of common MOS logic inverter stages.
6. Design devices and circuits to meet stated operating specifications.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: MEDICAL INSTRUMENTATION					
Paper Code: AEIE5132					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [8L]

Transduction Principles:
Resistive Transducers; Strain gauge type blood pressure transducers, Thermo resistive transducer, Capacitive Transducer, Piezoelectric Transducer; Flow transducers, measurement errors; definitions: accuracy, precision, sensitivity, resolution, threshold.

Module II - [8L]

Bio-potentials and electrodes:
Origin of Bio-potentials- structure, types and electrical activity of Cells, Resting and action potentials of cells, Different models,
Electrodes: Half-cell potential, Electrode-Electrolyte interface, Off-set potentials, Polarization- polarizable and non-polarizable electrodes, Ag/AgCl electrodes, motion artifact, Types and selection: Electrodes-surface, needle and micro electrodes and their electrical models.

Module III-[12L]

Biomedical signal processing:
Signal conditioners- OP-AMP, CMRR, filters, ECG, EMG, EEG –Lead systems and typical waveforms.
Image processing techniques- X-Ray Imaging, IR imaging, Ultrasonic imaging, CAT, MRI, Biotelemetry and patient monitoring.

Module IV-[8L]

Electrical safety: Model of Electrical Danger, Physiological Effects of Current, Ground Shock Hazards, Schemes of Accident Prevention.
Assisting and therapeutic instruments- Pacemakers, defibrillators, Hearing aids.

References:

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, *Biomedical Instrumentation and Measurements*, Second edition, Prentice-Hall India, 1997.
2. R.S. Khandpur, *Handbook of Biomedical Instrumentation*, 2 Edition, Tata McGraw Hill New Delhi, 1987.
3. John G. Webster, *Medical Instrumentation application and design*, Third edition, Wiley, 1997.

4. S. K. Venkata Ram, *Biomedical Electronics and Instrumentation*, Galgotia Publication Pvt. Ltd., New Delhi.
5. Geddes L.A and Baker L.E, *Principles of Applied Biomedical Instrumentation*, Third edition, Wiley-Interscience, 1989.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Explain the fundamental principles and applications of different transducers used for body parameter measurements.
2. Understand the physiology of biomedical systems and different methods in the design of biomedical instruments.
3. Learn the different methods of medical imaging systems, concepts related to the operations and analysis of biomedical instruments.
4. Design signal processing hardware circuits.
5. Learn various therapeutic devices.
6. Aware of the importance of electrical safety and apply it in the design of different assisting, therapeutic and diagnostic medical devices.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

	Subject Name: INSTRUMENTATION AND INDUSTRIAL AUTOMATION				
	Paper Code: AEIE5133				
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module I – [9L]
Static and dynamic characteristics of sensors, Resistive, Inductive and Capacitive sensors and signal conditioning circuits.
Temperature, pressure, flow and level measurement techniques.

Module II - [10L]
pH and conductivity sensors. Piezoelectric and ultrasonic sensors and its applications in process. Measurement of viscosity, humidity and thermal conductivity.
Process Control: P-I-D Control, Controller Tuning, Special Control Structures: Feedforward and Ratio Control, Predictive Control, Cascade Control, Advanced Control Schemes. Process and Instrumentation Diagrams.

Module III - [9L]
Introduction to transmitters, two wire and four wire transmitters, Smart and intelligent Transmitters. Design of transmitters.
Introduction to safety, electrical hazards, hazardous areas and classification, non-hazardous areas, enclosures – NEMA types, Electrical and Intrinsic safety; Zener Barrier.

Module IV-[8L]
Benefits and Impact of Automation on Manufacturing and Process Industries; Architecture of Industrial Automation Systems.
PLC, DCS, SCADA

References:

1. B. G. Liptak, *Instrumentation Engineers Handbook (Measurement),* Chilton Book Co.; 1994
2. John P. Bentley, *Principles of Measurement Systems,* Third edition, Addison Wesley Longman Ltd., UK, 2000.
3. E.O. Doebelin, *Measurement Systems - Application and Design*, Fourth edition, McGraw-Hill International Edition, New York, 1992.
4. U. A. Bakshi, A.V.Bakshi; *Instrumentation Engineering*; Technical Publications; 2009.
5. Harold E. Soisson; Instrumentation in Industry; John Wiley & Sons Canada, Limited, 1975.
6. B.E. Noltingk, *Instrumentation Reference Book*, 2nd Edition, Butterworth Heinemann, 1995.

7. L.D. Goettsche, *Maintenance of Instruments and Systems – Practical guides for measurements and control*, ISA, 1995.

Course Outcome:

Upon completing this course the student will be able to

1. Analyse the characteristics of resistive, inductive and capacitive sensors.
2. Learn various process variable measuring instruments.
3. Learn to read and draw the P&I diagrams.
4. Apply the knowledge of various control methodologies in industrial automation.
5. Learn industrial signal transmitter and safety in handling industrial instruments.
6. Explain the process automation and architecture.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: MECHATRONICS					
Paper Code: AEIE5141					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [8L]

Overview of Mechatronic and Physical System Modeling:
Introduction to Mechatronics, Mechatronic Design Approach, Elements of Mechatronics—Control Interface/Computing Hardware; Mechatronics-based Product Realization, Revolution of Mechatronics as a Contemporary Design Paradigm.
Introduction to System Modeling; Mechanical System, Electrical System, Fluid Systems, Thermal System, Translational and Rotational Mechanical System with spring, damper and mass.

Module II - [12L]

Transducers and Sensors and Actuators:
Introduction and Background, Difference Between Transducer and Sensor, Transducer Types, Transduction Principle, Photoelectric Transducers, Thermistor, Thermocouple, Inductive Transducers, Capacitive Transducer, Pyroelectric Transducers, Piezoelectric Transducer, Hall-effect Transducer, Ionization Transducer.
Introduction to Actuator types and Application Areas, Electromechanical Actuator, DC motor, AC motor, Fluid Power Actuators, Piezoelectric Actuators, Magnetostrictive Actuator, Memory-metal Actuator, Ion-exchange Polymer-metal Actuator, Micro Actuator.

Module III - [8L]

Signal Conditioning Theory, Circuits and Systems:
Introduction to signal conditioning, Voltage divider, Rectification, Diode Voltage Stabilizer, Clipping and Clamping Circuit, Amplifier, Instrument Amplifier, Bridge Circuit, Comparator, Filters- active and Passive, Oscillator, Multivibrator. Logic Systems-Synchronous and Asynchronous Sequential System Design.

Module IV - [8L]

Computers and Logic Systems, Software and Data Acquisition:
System Interfaces, Communication and Computer Networks, Fault Analysis in Mechatronic Systems, Architecture, Control with Embedded Computers and Programmable Logic Controllers.
Introduction to Data Acquisition, Measurement Techniques: Sensors and Transducers, A/D and D/A Converters, Computer-Based Instrumentation Systems, Software Design and Development, Data Recording and Logging.

References:

1. Robert H. Bishop, *The Mechatronics Handbook*, CRC Press 2006
2. W. Bolton, *Mechatronics, Electronic Control Systems in Mechanical and Electrical Engineering*, Pearson Education, 2003.
3. N. P. Mahalik, *Mechatronics, Principles, Concept and Applications*, McGraw Hill, 2003.
4. R. Isermann, *Mechatronic Systems Fundamental*, Springer, 2005.
5. Denny K. Miu, *Mechatronics*, Springer-Verlag, New York, 1993.

Course Outcome:

After the completion of the course, the students will be able to:

1. Design a machatronic system.
2. Identification of key elements of mechatronics system and its representation in terms of block diagram
3. Gain knowledge of different types of Sensors required for developing mechatronics systems.
4. Know the functions of different types of Actuators and identify their application areas.
5. Understand the concept of signal conditioning and use of interfacing systems such as comparetor, filters, amplifiers, etc.
6. Learn the concept of computer interfacing, networking, embedded systems, ADC, DAC and data logging systems.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: ADVANCED DIGITAL CONTROL SYSTEM					
Paper Code: AEIE5142					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [10L]

Review of Z- transform, inverse Z-transform, Mapping from s-plane to Z-plane, initial value theorem, final value theorem, etc.
Discrete-time Systems: Sampled signals, the zero and first order holds, linear difference equations and discrete transfer functions, block diagrams, and block diagram reduction.
Stability analysis techniques- Jury's stability test, bi-linear transformation, Pulse transfer function and data holds, Development of pulse transfer function of various block configurations.

Module II - [8L]

Digital Control Designs using Classical Methods: digital PID controller, Deadbeat controllers, Dahlin controller, ringing and pole-placement. Predictive controller design, Internal-Model control.

Module III-[10L]

Tools for designing: root locus method, frequency response based designs, introduction to direct design methods, State variable model , canonical forms , characteristic equation, solution to discrete state equation,, controllabiljty and observability of discrete state space models.

Module IV-[8L]

Adaptive Control and Self Tuning: Gain scheduling, Model reference adaptive control, Self-tuning regulators, Cascade control, and Feedforward control – Introduction and design fundamentals, and applications.

References:

1. K. Ogata, *Discrete Time Control Systems*, Prentice Hall, 2/e, 1995.
2. B. C. Kuo, *Digital Control Systems*, Oxford University Press, 2/e, Indian Edition, 2007.
3. M. Gopal, *Digital Control and State Variable Methods*, Tata Mcgraw Hill, 2/e, 2003.
4. G. F. Franklin, J. D. Powell and M. L. *Workman, Digital Control of Dynamic Systems*, Addison Wesley, 1998, Pearson Education, Asia, 3/e, 2000.
5. K. J. Astroms and B. Wittenmark, *Computer Controlled Systems - Theory and Design*, Prentice Hall, 3/e, 1997.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Understand transformation technique from continuous to discrete domain.
2. Realize the fundamental principles for design of Digital Control system and will gain industrial application based knowledge for their implementations.
3. Learn various digital control algorithms for dusigning digital controllers.
4. Develope algorithms for applications based various digital controllers
5. Learn analyze different discrete control systems using various time and frequency domain tools.
6. Aware of advanced understanding of adaptive and self tuning principles and applications.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: ADVANCED OPTICAL INSTRUMENTATION					
Paper Code: AEIE5143					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [8L]

Optical Fibers and their Performances:
Principle of light propagation through fiber-different types of fibers and their properties-fiber characteristics-Absorption losses-scattering losses-dispersions-connectors and splicer-fiber termination-optical sources-optical detectors.

Module II - [8L]

LED:

Structure, characterization, hetero-junction, power and efficiency calculations

Optical detectors:

PIN photodiode, avalanche photodiode, phototransistor, LDR, Photovoltaic cell.

Module III - [11L]

LASER fundamentals:
Fundamental characteristics of lasers-Three level and four level lasers-Properties of lasers-laser modes-Resonator configuration-Q switching and mode locking- cavity damping-Types of lasers-gas lasers, liquid laser, solid lasers, semi-conductor lasers.

Industrial applications of LASER:
Laser for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect- Material processing -Laser Heating, Welding, Melting and trimming of material, Removal and vaporization.

Module V – [9L]

Optical Fiber, Hologram and Medical applications:
Fiber optic sensors-fiber optic Instrumentation system-Different types of modulators-Inferometric method of measurement of length-Moire fringes-Measurement of pressure, temperature, current, voltage, liquid level and strain.
Holography-Basic Principle-Methods-Holographic Inferometry and application, holography for non-destructive testing-holographic components-Medical applications of laser and tissues interactive.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

References:

1. J.M. Senior, *Optical Fiber Communication – Principles and Practice*, Prentice Hall of India, 1985.
2. J. Wilson and J. F. B. Hawkes, *Introduction to Opto Electronics*, Prentice Hall of India, 2001.
3. Donald J. SterlingJr, *Technicians Guide to Fiber Optics*, 3rd Edition, Vikas Publishing House, 2000.
4. M. Arumugam, *Optical Fiber Communication and Sensors*, Anuradha Agencies, 2002.
5. John F. Read, *Industrial Applications of Lasers*, Academic Press, 1978.
6. Monte Ross, *Laser Applications*, McGraw Hill, 1968
7. G. Keiser, *Optical Fiber Communication*, McGraw Hill, 1995.
8. Mr. Gupta, *Fiber Optics Communication*, Prentice Hall of India, 2004.

Course Outcome:

After the completion of the course, the students will be able to:

1. Learn the techniques of communications using optical fiber.
2. Characterize structures and performance of LEDs and lasers.
3. Learn the structures and performance of photo detectors (like photo diode, PIN diode, APD etc).
4. Learn the fundamentals of LASER.
5. Explain the techniques of measurement of distance, length, velocity, acceleration, current, voltage using laser. Formulate the structure of generalized measurement system.
6. Acquire knowledge on basic principle of holography and its uses in different fields such as nondestructive testing, medical field etc.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: DIGITAL SIGNAL PROCESSING LAB					
Paper Code: AEIE5151					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	4	4	2

1. Generations of different types of sequences and operations on them.
2. Simulation of some simple discrete-time systems and investigation of their time domain properties.
3. Discrete Fourier Transform, Fast Fourier Transform, Spectral Analysis with FFT, Time varying spectra, Spectrogram of Chirp Signal, Wavelet transform.
4. Design of FIR filters and their realizations.
5. Design of IIR filters and their realizations.
6. Design of decimator, interpolator and filter banks.
7. Real Time signal Processing by TI C6713 and Code Composer Studio – Introduction to Code Composer Studio as an integrated development environment, Creating projects, writing and compiling programs for the C6713 DSK, Real-time FIR and IIR filtering, The fast Fourier transform (FFT), adaptive filtering.

References:

1. Vinay Ingle and John Proakis, *Digital Signal Processing Using MATLAB*, 2nd edition, CL-Engineering, 2006.
2. Thad B. Welch, et al., *Real-Time Digital Signal Processing from MATLAB® to C with the TMS320C6x DSPs*, Second Edition. 2nd Edition, CRC Press, 2011, ISBN-13 978-1439883037.
3. Rulph Chassaing, *Digital Signal Processing and Applications with the C6713 and C6416 DSK*, John Wiley & Sons, Inc., Hoboken, New Jersey, 2005.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Generate different types of sequences and perform operations on them using MATLAB.
2. Write MATLAB programs to determine time domain properties of the discrete time signals.
3. Perform DFT, FFT and IDFT of discrete signals in MATLAB.
4. Design FIR and IIR digital filters and implement decimator, interpolator and filter banks of discrete signals using MATLAB.
5. Get an exposure on DSP processor and code composure studio for implementation of real time digital signal processing.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: PROGRAMMING LANGUAGE FOR EMBEDDED IOT SYSTEMS LAB					
Paper Code: AEIE 5152					
Contact hours per week:	L	T	P	Total	Credit points
	0	0	4	4	2

1. Introduction to NodeMCU and Arduino IDE for ESP8266
2. Experiments with GPIO devices:
   a) Input: Push button, toggle switch, Temp sensor LM35
   b) Output: Blink LED, Relay control, Rotate LEDs.
3. Programming Arduino UNO to connect with ESP8266-01
4. Experiments with WiFi on Thingspeak cloud.
   a) Send LM35 temperature data (publish).
   b) Receive temperature data.
   c) Read data from cloud with Python client and print it on the console.
5. Real time data publish of temperature and humidity data from DHT11 to Thingspeak cloud.
6. Configure Raspberry Pi 3 as IoT server using Python.
7. Introduction to Android Studio for Android Things IoT service on Raspberry Pi 3.
8. GPIO operations for Android Things using Java ME/Kotlin.
9. Programming Node MCU with micro Python.

Course Outcome:

After the completion of the course, the students will be able to:

1. Design and conduct experiments with input and output devices using a Node MCU.
2. Perform programming with IIoT cloud service using low power microcontrollers and Raspberry Pi.
3. Interface a sensor with Node MCU for IoT applications.
4. Implement Android Things app using Java ME/Kotlin
5. Perform programming with MicroPython.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

	Subject Name: PROCESS CONTROL SYSTEM DESIGN				
	Paper Code: AEIE5202				
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [8L]
Introduction to process control, control objectives and benefits.

Process modeling and identification: mathematical modelling principles, types of models, modelling and analysis for process control, empirical (linear) dynamic models, model structure considerations, model identification.

Process dynamics: characteristics of a few processes such as heat exchangers, boilers and condensers, model analysis and control, system order reductions.

Module II - [10L]
Optimization of process operation: introduction to real-time optimization, optimization and its benefits, hierarchy of optimization, issues to be addressed in optimization, degrees of freedom selection for optimization, procedure for solving optimization problems, problems in optimization, model building, and the objective function.

Designing process control systems – different approaches: supervisory, direct digital, distributed control system: architecture, communication data links, control information and display unit; redundancy, reliability, data transfer protocols, standard interfaces. SCADA architecture.

Module III - [10L]
Adaptive control: introduction, deterministic self-tuning regulator: indirect and direct self-tuning regulator, model reference adaptive system: design of MRAS using MIT rule, gain scheduling control, application of adaptive controller in process.

Intelligent control: introduction, benefits and application scope of fuzzy logic, neural network and genetic algorithm in process control, fuzzy sets and crisp sets, design of fuzzy controller, industrial applications.

Module IV-[8L]
Variation of algorithm designs, comparisons. Case studies of specific control schemes such as temperature of oven/ furnace, thickness and flatness of rolled metal sheets, boiler drum level control, refinery crude oil distillation, resin plant - design details of the algorithm developed and the complete scheme.

References:

1. Thomas E. Marlin, *Process Control: Designing Processes and Control Systems for Dynamic Performance*, 2nd Edition, McGraw-Hill.

2. B. Roffel and B. H. L. Betlem, Advanced Practical Process Control, Springer-Veriag Berlin Heidelberg 2004.
3. J. R. Leigh, *Applied Digital Control*, Prentice Hall.
4. Deshpande & Ash, *Elements of Computer Process Control*, ISA.
5. C. L. Smith, *Digital Computer Process Control*, Intext Education Publishers, 1972.
6. Astrom, *Adaptive Control*, Pearson, 2nd Ed.
7. B. Sohlberg, *Supervision and Control for Industrial Processes*, Springer-Verlay, 1998.
8. M. Murari & E. Zafirion, *Robust Process Control*, Prentice Hall, 1989 –.

Course Outcome:

After the completion of the course, the students will be able to:

1. Explain the importance of process modeling, identification and analyze process dynamics.
2. Address the importance of optimization and solve the the optimization problem.
3. Understand the architecture of process control system like DCS and SCADA.
4. Apply their knowledge of adaptive control for effective process control.
5. Design process control system applying different linear, nonlinear and soft-computing techniques.
6. Explain the control mechanism of different industrial processes.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: INSTRUMENTAL METHODS OF ANALYSIS					
Paper Code: AEIE5233					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [10L]

Basics of Analysis and Techniques: Qualitative and quantitative analysis, Sample Handling System (SHS), Steam and Water Analysis System (SWAS).
Electro-Analytical methods: REDOX reactions, Half-cells, Electrode potentials, Calculation of Cell potentials, Electrochemical cells.
Pollution Monitoring Analyzers: O_2, CO_x, NOx, SOx measuring analyzers, Particulate Analyzer.

Module II - [8L]

Radiation spectrometry: Electromagnetic Radiation and Electromagnetic Spectrum.
Absorption Spectroscopy: transmittance and absorbance, Beer-Lambert law
Ultraviolet-Visible absorption spectrometry, Infrared spectrometry, quantitative determination of different analytes effects of instrumental noise on analysis.

Module III - [10L]

Atomic spectroscopy: Introduction to spectrometric methods, Atomic absorption and Atomic fluorescence spectrometry,
Mass spectrometry: types, principle, instrumentation, identifying elements present in a sample (Organic and inorganic),
Raman spectrometry: principle, instrumentation, applications,
X-Ray Spectrometry: fundamental principle, X-Ray absorption spectrometry, X-Ray fluorescence spectrometry, X-Ray monochromator, detectors and applications.

Module IV - [8L]

Gas Chromatography: fundamental of chromatographic separation, chromatography column, instrumentation, Gas-Solid chromatography, application.
Liquid Chromatography: LC, HPLC, instrumentation. Applications in food, pharmaceutical, petrochemical, etc. industries.

References:

1. Skoog, Holler and Crouch, *Instrumental Analysis*, Cengage Learning, India, 2007.
2. R.D. Braun, *Introduction of Instrumental Analysis*, Pharma book syndicate, Hyderabad, 2006.

3. R. S. Khandpur, *Handbook of Analytical Instruments*, Tata McGraw Hill, New Delhi, 2010.
4. Willard, Merritt, Dean and Settle, *Instrumental methods of Analysis*, CBS publishers, New Delhi.
5. D. Patranabis, *Principles of Industrial Instrumentation*, Tata McGraw Hill, New Delhi.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Learn the basic techniques and instruments adopted for quantitative and qualitative analysis of samples.
2. Identify different components of spectrometers and acquire knowledge about their functioning.
3. Explain the UV-VIS, IR and FTIR spectrophotometers
4. Learn atomic spectrophotometric analysis.
5. Learn Raman and X-Ray-based spectrophotometric analysis.
6. Apply the chromatographic techniques for various analytical applications.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Audit Course Syllabus

Course Name : DISASTER MANAGEMENT					
Course Code: CSEN5116					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	**0**	**0**	**2**	**0**

Module I (6L)
Introduction on Disaster:

- Introduction on Disaster - Disaster: Definition; Types of Disaster
- Natural Disaster: such as Flood, Cyclone, Earthquakes, Land slides etc.
- Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures (Building and Bridge), War & Terrorism etc.
- Differences, Nature and Magnitude
- Factors Contributing to Disaster Impact and Severity - Repercussions of various types of Disasters Economic Damage; Loss of Human and Animal Life; Destruction of Ecosystem; Outbreaks of Disease and Epidemics; War and Conflict
- Natural Disaster-prone areas in INDIA - Areas prone to; Earthquake; Floods and Droughts; Landslides and Avalanches; Cyclonic And Coastal Hazards such as Tsunami;
- Lessons Learnt from Recent Disasters

Introduction to Disaster Management:

- What is Disaster Management
- Different Phases of Disasters
- Disaster Management Cycles
- Disaster Management Components - Hazard Analysis; Vulnerability Analysis; Prevention and Mitigation; Preparedness; Prediction and Warning; Response; Recovery;
- Disaster Management Act, 2005
- National Disaster Management Structure
- Organizations involved in Disaster Management

Module -II (6L)
Overview on Hazard Analysis and Vulnerability Analysis Disaster Preparedness:

- Disaster Risk Assessment People's Participation in Risk Assessment
- Disaster Risk Reduction
- Preparedness Plans
- Community preparedness: Emergency Exercises/ Trainings/Mock Drills

Disaster Prediction and Warning:

- Activities - Tracking of disaster; Warning mechanisms; Organizational response; Public education; Communication; Evacuation planning

- Current tools and models used for prediction and early Warnings of disaster - Application of Remote Sensing; Data From Meteorological and other agencies; Smartphone/ Web based Apps for Disaster Preparedness and Early Warning used in different parts of Globe

Module -III (6L)
Disaster Response:
- Crisis Management: The Four Emotional Stages of Disaster - Heroic Phase; Honeymoon Phase; Disillusionment Phase; Reconstruction Phase
- Need for Coordinated Disaster Response - Search, Rescue, Evacuation, Medical Response and Logistic Management; Psychological Response and Management (Trauma, Stress, Rumor and Panic)
- Role of Government, International and NGO Bodies

Post-disaster Situation Awareness:
- Need for Situation Awareness in Post Disaster scenario
- Challenges in communication of situational data from affected areas
- Need for community-driven disaster management for reliable situation awareness
- Crowd-sourcing of situational data: Issues and challenges

Post-disaster Damage and Need Assessment:
- Current Trends and Practices – RAPID Damage and Need Assessment
- SPHERE standards in Disaster Response
- ICT based techniques for Post-disaster damage and need assessment

Module -IV (6L)
Rehabilitation, Reconstructions and Recovery:
- Reconstruction and Rehabilitation as a Means of Development.
- Post Disaster effects and Remedial Measures
- Creation of Long-term Job Opportunities and
- Livelihood Options
- Disaster Resistant House Construction
- Sanitation and Hygiene
- Education and Awareness
- Dealing with Victims' Psychology
- Long-term Counter Disaster Planning

Disaster Mitigation:
- Meaning, Concept and Strategies of Disaster Mitigation
- Emerging Trends in Mitigation
- Structural Mitigation and Non-Structural Mitigation
- Programs of Disaster Mitigation In India

References:
1. R. Nishith, A.K. Singh, *Disaster Management in India: Perspectives, issues and strategies*, New Royal book Company.

2. P. Sahni et.al. (Eds.), *Disaster Mitigation: Experiences and Reflections*, Prentice Hall of India, New Delhi.
3. S. L. Goel, *Disaster Administration and Management Text and Case Studies*, Deep & Deep Publication Pvt. Ltd., New Delhi.

Course Outcomes:

After the completion of this course, students should be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Subject Name: **Advanced Algorithms Lab**					
Paper Code: CSEN5251					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course Outcomes/Learning Objectives:

- On completion this course, students are expected to be capable of understanding basic ability to analyze algorithms and to determine algorithm correctness and time efficiency class.
- Beside this students should be able to understand basic features of different algorithm design paradigms like divide and conquer, greedy, dynamic programming etc.
- Last but not the least, students will be able to apply and implement learned algorithm design techniques and data structures to solve various real life problems.

In this laboratory Students should run all the programs using C programming language on LINUX platform and then estimate the running time of their programs in best, worst and average case situations for large dataset.

A tentative outline of the laboratory is given below:

- Divide and Conquer: Find Maximum and Minimum element from a array of integer using Divide and Conquer approach
- Divide and Conquer: Implement Quick Sort using Divide and Conquer approach. Check the running time for different positions of pivot elements. Implement the randomized version of quick sort
- Dynamic Programming: Find the minimum number of scalar multiplication needed for chain of Matrices
- Implement Single Source shortest Path for a graph (Dijkstra and Bellman Ford Algorithm)
- Dynamic Programming: Implement all pair Shortest path for a graph (Floyd- Warshall Algorithm)
- Greedy method: implement fractional Knapsack Problem, MST by Prim's algorithm
- Greedy method: Implement MST by Kruskal's algorithm by using Union operation on Disjoint data Structures.
- Graph Traversal Algorithm: Implement Depth First Search (DFS), application of DFS (do topological sorting, identify strongly connected components)
- Implement KMP algorithm for string matching
- Implement Ford-Fulkerson algorithm to get maximum flow of a given flow network.

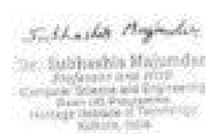
Subject Name: Soft Computing Lab					
Paper Code: CSEN5252					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

COURSE OUTCOMES

- An understanding of fundamental concepts and methods of machine learning and its applications.
- An ability to analyze and evaluate simple algorithms for pattern classification.
- An ability to design simple algorithms for pattern classification, code them with Python programming language and test them with benchmark data sets.

A tentative outline of the laboratory is given below:

1. Introduction to Matlab/Python, Arrays and array operations, Functions and Files.
   Familiarization with a few ML Tools such as Excel, WEKA, R, Python and TensorFlow
2. Study of neural network toolbox and fuzzy logic toolbox.
3. Simple implementation of Artificial Neural Network and Fuzzy Logic
4. Implementation of latest soft computing techniques using one of the above tools.
5. Regression (single and Multiple Variables) linear and non-liner;
6. Logistic regression
7. Classifiers: K-NN, Naïve Bayes Classifier, Perceptron, Multi Layer Perceptron
8. Clustering Algorithms: K-Means , DB-Scan
9. Applications of ANN and SVM using ML tools



Paper Name: **Advanced Discrete Mathematics and Statistical Methods (M. Tech. CSE)**					
Paper Code: **MATH 5101**					
Contact hours per week:	L	T	P	Total	Credit Points
	4	0	0	4	4

After successfully completing this course the students will be able to:

1. To understand the mathematical fundamentals that is prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
2. To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.
3. To study the principles of enumeration.
4. To equip oneself with the techniques used in graph theory.

Detailed Syllabus:

Module I: [10L]

Probability and Statistics I: Review of Basic Probability: Sample Space, Events, Classical Definition , Addition and Multiplication Rule, Conditional Probability, Axiomatic definition of Probability and related problems, Bayes' Theorem and related problems, General properties of probability distributions, Expectation and Variance.

Module II: [10L]

Probability and Statistics II: Moment generating and Characteristic functions**,** Special Distributions: Binomial and Normal Distribution, Measures of Central Tendency: Mean , Median , Mode, Measures of Dispersion: Standard deviation and Variance, Relation between random variables, Covariance and Correlation Coefficient, Linear Regression equations.

Module III: [10L]

Topics in Combinatorial Mathematics: Pigeon Hole Principle, Permutations & Combinations, Binomial Coefficients, Recurrence Relations & Generating Functions, Properties of Fibonacci Numbers, Principle of Inclusion & Exclusion, Polya's Theory of Counting, Ramsey's Theorem.

Module IV: [10L]

Advanced Graph Theory: Tree, Binary Tree, Spanning Tree, Walk, Path, Cycle, Hamiltonian Graph, The Travelling Salesman Problem, Euler Graph, The Chinese Postman Problem, Planar Graph, Euler's Formula for Planar Graph and Related Problems, Examples of Non-Planar Graphs, Kuratowski's Theorem, Matching and Augmenting Paths, Hall's Marriage Theorem and Related Problems, Vertex Colouring, Chromatic Polynomials.

Sandip Chatterjee

References:

1. Discrete Mathematics & Its Applications, K H Rosen, McGraw Hill
2. Introduction to Graph Theory, D G West, Prentice-Hall of India
3. Discrete Mathematics for Computer Scientists and Engineers, J L Mott, A Kandel and T P Baker, PHI
4. Introduction to Probability and Statistics for Engineers and Scientists, S.Ross, Elsevier
5. Fundamentals of Mathematical Statistics, S.C.Gupta and V.K.Kapoor, Sultan Chand and Sons

Advanced Discrete Mathematics
Paper Code: MATH5102
Course: M.Tech Stream: CSE

Contact : 4L

***Mathematical Foundations*:**
Concepts of Countable and Uncountable Sets; Relations: Partial & Total Orderings, Hasse Diagrams, Partially Ordered Sets (POSETs) : Minimal, Maximal, Greatest, Least Elements; Properties of Lattices, Distributive and Complemented Lattices, Boolean Algebra. 10L

***Properties of Integers*:**
Well Ordering Principle, Weak & Strong Principles of Mathematical Induction, Fundamental Theorem of Arithmetic, Euclidean Algorithm, Properties of GCD, Linear Congruences, Residue Classes, Fermat's Little Theorem, Euler's Phi Function, Euler's Theorem on Congruences & Related Results, Chinese Remainder Theorem. 10L

***Topics in Combinatorial Mathematics*:**
Pigeon Hole Principle, Permutations & Combinations, Binomial Coefficients, Recurrence Relations & Generating Functions, Properties of Fibonacci Numbers, Principle of Inclusion & Exclusion, Polya's Theory of Counting, Ramsey's Theorem. 10L

***Advanced Graph Theory*:**
Tree, Binary Tree, Spanning Tree, Walk, Path, Cycle, Hamiltonian Graph ,The Travelling Salesman Problem, Euler Graph, The Chinese Postman Problem , Planar Graph, Euler's Formula for Planar Graph and Related Problems, Examples of Non-Planar Graphs, Kuratowski's Theorem, Matching and Augmenting Paths, Hall's Marriage Theorem and Related Problems, Vertex Colouring, Chromatic Polynomials. 10L

Total: 40L

***References*:**

[1] Discrete Mathematics & Its Applications (6^{th} Ed), K H Rosen, McGraw Hill, 2007
[2] Introduction to Graph Theory (2^{nd} Ed), D G West, Prentice-Hall of India, 2006
[3] Concrete Mathematics, R. L. Graham, D. E. Knuth and O. Patashnik: Addison Wesley, 1994.
[4] Introduction to Combinatorial Mathematics, C L Liu, McGraw-Hill, 1967
[5] Discrete Mathematics for Computer Scientists and Engineers (2^{nd} Ed), J L Mott, A Kandel and T P Baker, PHI, 2002
[6] A Friendly Introduction to Number Theory : J.H. Silverman (Pearson Education)

Sandip Chatterjee

M. Tech. Detailed Syllabus - Semester III

Professional Elective V

CSEN6131 – CSEN6139	Professional Elective V
CSEN6131	Mobile Applications and Services
CSEN6132	Compiler for HPC
CSEN6133	Computational Complexity
CSEN6134	Fault Tolerant Computing
CSEN6135	Approximation Algorithms
CSEN6136	Randomized Algorithms
CSEN6137	Information Retrieval
CSEN6138	Social Network Analysis
CSEN6139	Quantum Computing

Subject Name: Mobile Applications and Services					
Paper Code: CSEN 6131					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

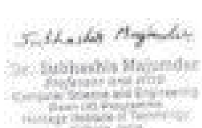
1. Understand the methodology and syntax of implementing applications for mobile devices working in the Android and iOS Platform
2. Understand the concept of RESTful and Non-RESTful apps
3. Create and Incorporate Web/Cloud Services
4. Understand the working of Mobile Sensors and develop apps to interact with them
5. Learn Security and Trust Management
6. Develop the understanding of Privacy and Ethics

Module I: Introduction to the Mobile Device Architecture and Android Architecture (9L)
Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols. The Three-Tiered Architecture: Model-View-Controller, Client / Server Architecture. Mobile Architectures: Thick Client, Thin Client. Android Architecture: Introduction to the Android Architecture, Android Studio, Building Activities, Intents and Services, Lifecycle Management.

Module II: Introduction to MAC and iOS Architecture (9L)
A History of iOS and Mac Development. Xcode and iOS Architecture. iOS App Components.

Module III: Data Management and Sensors (9L)
Android Data Management. iOS Data Management. REST: Service Oriented Arch, Web Services. Security / OAUTH. Sensor Ethics, Hardware and Sensors.

Module IV: User Interface (9L)
User Interface Design: UI Design, Accessibility, Android UI and Material Design Principles, Apple UI and HIG. Wireframing. Privacy Policies and Analytics, Monetization. Cross-Platform Development. Wearables, AR, VR, and Mobile.



References:

1. https://www.infoworld.com/article/2623833/mobile-development-101--what-you-need-to-know.html
2. https://developer.android.com/guide/index.html
3. https://developer.apple.com/library/archive/referencelibrary/GettingStarted/DevelopiOSAppsSwift/
4. https://developer.apple.com/documentation/
5. https://developer.android.com/guide/topics/data/data-storage.html
6. https://developer.apple.com/library/archive/documentation/Cocoa/Conceptual/CoreData/nsfetchedresultscontroller.html
7. https://www.restapitutorial.com/
8. http://tutorials.jenkov.com/oauth2/overview.html
9. https://developer.android.com/guide/topics/sensors/sensors_overview.html
10. http://w3c.github.io/Mobile-A11y-TF-Note/#
11. https://material.io/design/introduction/#
12. https://developer.apple.com/design/human-interface-guidelines/ios/overview/themes/
13. https://developer.android.com/training/design-navigation/wireframing.html
14. https://www.docracy.com/mobileprivacy/
15. https://toucharcade.com/2015/11/13/paid-games-dont-work-for-developers-heres-why-the-carter-crater/
16. https://cordova.apache.org/docs/en/latest/
17. https://gizmodo.com/all-of-the-best-augmented-reality-tricks-your-iphone-ca-1805804012

Subject Name: Compiler for HPC					
Paper Code: CSEN6132					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

After completion of the course, students would be able to:

1. Remember the basic concepts of code generation and machine independent optimizations.
2. Learn various scheduling techniques and register allocation for exploiting Instruction Level Parallelism.
3. Be familiar with some well-known memory locality optimizations and demonstrate their understanding of locality optimization in different algorithms.
4. Apply the concept and compiler techniques for exploiting Data Level Parallelism.
5. Estimate the scope and level of parallelism in any application.
6. Design new basic block scheduling algorithms for data dependence graph applying the concept gained from the course.

Module-I (8L)

Review of code generation: optimization of basic blocks, peephole optimization. Registers allocation and assignment: Global register allocation, Register allocation by graph colouring. Optimal code generation for expressions: Ersov numbers, Evaluation expressions with insufficient supply of registers.

Module-II (10L)

Instruction level parallelism: Processor architectures; Code scheduling constraints: data dependence, Control dependence; Basic block scheduling: Data dependence graph, List scheduling of basic blocks, Prioritized Topological orders; Global code scheduling: Primitive, upward, and downward code motion; Introduction to Global scheduling algorithms; Software pipelining: Software pipelining of loops, Scheduling acyclic and cyclic data dependence graphs.

Module-III (8L)

Memory hierarchy of a computer and its optimization: reducing fragmentation. Basic introduction to garbage collection: reachability, Reference counting garbage collectors; Introduction to trace-based collector: a basic Mark-and-Sweep collector, Optimizing Mark-and-Sweep; Mark-and-Compact garbage collector; Parallel and concurrent garbage collection; Partial object relocation.

Module-IV (10L)

Optimizing for parallelism and locality: Multiprocessors and parallelism in applications, Loop-level parallelism, Data locality. Optimization issues in Matrix multiplication algorithm, Different types of Data reuses; Identification of Synchronization-free parallelism; Synchronization between parallel loops; Pipelining: basic introduction, Parallelism with minimum synchronization; Locality optimization: Temporal locality of computed data, Partition interleaving.

Dr. Subhashis Majumder

References

1. Compilers: principles, techniques, and tools - Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Pearson Education.
2. Advanced compiler design implementation - Steven S. Muchnick.
3. Optimizing compilers for modern architectures: a dependence-based approach – Randy Allen, Ken Kennedy.

Subject Name: Fault Tolerant Computing					
Paper Code: CSEN6134					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

Students who complete the course will demonstrate the ability to do the followings:
1. understand reliability and fault tolerance in electronic system.
2. understand different types of defects, faults, errors and hazards.
3. know how to create a stochastic modeling of failure / hazard.
4. solve the faults / hazards.
5. analyze reliability modeling of redundancy systems.
6. evaluate reliability, availability, serviceability or real time systems.

Module I: Preliminaries (Data Structures and Basic Algorithms) (9L)
Principles of Fault Tolerance; Reliability Requirements; Hardware F-T Techniques; System Abstractions; Software Structuring Schemes;

Module II: (9L)
Techniques for Different Stages of Fault Tolerance; Techniques for Different Types of Faults;

Module III: (9L)
Fault Tolerance in Distributed Systems; Fundamental Problems in Coordination; Communication and Remote Operation over Unreliable Channels; Fault Tolerant Control and Coordination Algorithms Design;

Module IV: (9L)
F-T System Abstractions/Functions; System Mechanisms for F-T; Fault Tolerant Programming Paradigms; Modeling and Analyzing F-T Distributed Systems.

References:

1. "Reliability of computer systems and networks" by Martin L. Shooman, John Wiley and Sons Inc., 2002, ISBN 0-471-29342-3.
2. Anderson, T., and P.A. Lee, Fault-Tolerant Principles and Practices, Prentice-Hall Int'l., London, 1981.
3. Hwang, K., and F.A. Briggs, Computer Architecture and Parallel Processing, McGraw-Hill, 1984.
4. Jalote, P. Fault-Tolerance in Distributed Systems, ISBN 0-13-301367-7, Prentice-Hall, 1994.
5. Johnson, B.W., Design and Analysis of Fault-Tolerant Systems, Addison Wesely, 1989.
6. Leveson, Nancy G., Safeware, system safety and computers, Addison Wesely, 1995.
7. Pradhan, D.K., Fault-Tolerant Computing -- Theory and Techniques, (2 Volumes), Prentice-Hall, 1986.
8. Pradhan, Dhiraj K., Fault-Tolerant Computer System Design, ISBN 0-13-057887-8, Prentice-Hall PTR , 1996.
9. Sahner, R.A., K.S. Trivedi and A. Puliafito, Performance and Reliability Analysis of Computer Systems, Kluwer Academic Publishers, 1996.
10. Sieworek, and R.S. Schwarz, The Theory and Practice of Reliable System Design, Digital Press, 1982.
11. Storey, Neil, Safety-Critical Computer Systems, Addison Wesely, 1995.
12. Martin L. Shooman, Reliability of computer systems and networks, John Wiley and Sons Inc., 2002, ISBN 0-471-29342-3. Trivedi, K.S., Probability and Statistics with Reliability, Queuing, and Computer Science Applications, Prentice-Hall, 1982.

Subject Name: Approximation Algorithms					
Paper Code: CSEN6135					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
On completion of this course, students would be able to:

1. Remember the approach of designing different approximation algorithms to solve various hard problems.
2. Analyze a given real life problem to determine it hardness, and then define an approximation algorithm for it.
3. Learn the limits of approximation and the basic ways of proving hardness of approximation
4. Choose appropriate approximation algorithms and use it for a specific hard problem.
5. Hypothesize for a critical problem, where graph is involved as an absolutely necessary component.
6. Gather some knowledge about the recent developments in the area of approximation algorithmic design

Module 1 (9L)
NP-Completeness: Polynomial time, NP-Hardness, NP-Completeness and reducibility, NP-Completeness proofs. Approximation Algorithms: Fundamentals and Concepts. Performance Ratio. Polynomial approximation scheme (PTAS), Fully polynomial time approximation scheme (FPTAS).

Module 2 (9L)
Approximation algorithms for scheduling. List scheduling. Job scheduling with deadlines. Identical aparallel machines. Unrelated parallel machines. Bin Packing. Next fit, first fit, online and offline algorithms. Average case analysis.

Module 3 (9L)
Approximate covering and poacking, set cover, vertex cover, independent set.
Approximation algorithms for highly connected subgraphs. Weighted and unweighted vertex connectivity. Weighted and unweighted edge connectivity. Strong connectivity.

Module 4 (9L)
Approximation Algorithms for Geometric problems. Euclidean TSP, Steiner tree problems, Steiner ratio, Minimum weight triangulation with steiner points, Clustering, K-minimum spanning tree, polygon separation, point set separation.
Hardness of approximations. Inapproximability results. PCP theorem. PCP and inapproximability of MAX-3SAT.

Text Books:

1. Approximation Algorithms by Vijay Vazirani, (Springer, 2001)
2. Approximation Algorithms for NP-Hard Problems by Dorit S. Hochbaum (PWS Publishing Company, 1997)

Subject Name: Randomized Algorithms					
Paper Code: CSEN6136					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

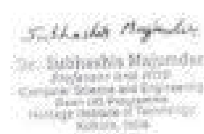
After completion of the course, students would be able to:

1. Remember the basic concepts of probability calculus in algorithmic context and apply the probabilistic method to show the existence of certain combinatorial objects
2. Demonstrate their understanding of algorithmic randomization for a given problem.
3. Understand and use suitable mathematical tools to design randomized algorithms and analyze their performance.
4. Calculate proper upper bounds for the expected running time of simple randomized algorithms.
5. Estimate how a randomized algorithm performs asymptotically better than the best known exact deterministic algorithms for that problem.
6. Design simple randomized algorithms that run fast or that return the correct output with high probability.

Module 1 (9L)
Introduction. Basic Probability Theory. Moments and deviations, Markov and Chebyshev inequalities. Tail Estimates and the Chernoff Bound. Conditional Expectation and Martingales.
The Probabilistic Method. Markov Chains and Random Walks.

Module 2 (9L)
Sorting: Randomized Quicksort. Analysis. Comparison with average case analysis of deterministic Quicksort.
Searching: Skip Lists.

Module 3 (9L)
Randomized Incremental Construction. Randomized Data Structures for dynamic data.
Randomized Graph Algorithms.



Module 4 (9L)
Implementation issues. De-randomization. Applications: Algorithms for Data Streams.

Text Book:

1. Randomized Algorithms by Rajeev Motwani and Prabhakar Raghavan. (Cambridge University Press).

References:

1. Computational Geometry: An Introduction through Randomized Algorithms by Ketan Mulmuley, Prentice Hall.

Course Name: Information Retrieval					
Course Code: CSEN6137					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Objectives:
The objective of the course is to introduce information retrieval models and query languages. Application of web search and information retrieval in social networks is also included.

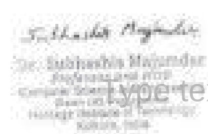
Course Outcomes:
After completion of course, students would be able to:
1. Identify basic theories and analysis tools as they apply to information retrieval.
2. Develop understanding of problems and potentials of current IR systems.
3. Learn and appreciate different retrieval algorithms and systems.
4. Apply various indexing, matching, organizing, and evaluating methods to IR problem
5. Be aware of current experimental and theoretical IR research.
6. Analyze and design solutions for some practical problems.

Module I: (9L)
Information retrieval model, Information retrieval evaluation; Document Representation – Boolean Model, Posting Lists, Inverted Indices, Skip Lists; Query languages and query operation – proximity search, Phrase Queries Meta-data search; Tolerant Retrieval – B-Trees, Permuterm Index, Edit Distance – Different variations

Module II: (9L)
Indexing Construction and Searching – BSBI, SPIMI, Heap's Law Zipf's Law; Scoring and ranking feature vectors, tf-idf various schemes; Evaluation and computations of scores and ranked retrieval; Relevance feedback

Module III: (9L)
Text and multimedia languages, Language Models – Query Likelihood Models; Text Classification and Naïve Bayes – Bernoulli model, feature selection; Vector Space Classification – kNN, Rocchio Classification

Module IV: (9L)
Flat Clustering – K means, K medoids, Evaluation of clustering, Models for clustering; Hierarchical Clustering – Single Link, Complete Link, Group Average and Centroid, Inversion Points, DivisiveClustering – Basics; Latent Sematic Analysis – SVD, Low Rank Approximations;
Web Search Basics, Link Analysis – Page Rank, HITS.



Type text here

References:

1. C. D. Manning, P. Raghavan and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008 (available at http://nlp.stanford.edu/IR-book).
2. Chakrabarti, S. (2002). Mining the web: Mining the Web: Discovering knowledge from hypertext data. Morgan-kaufman.
3. B. Croft, D. Metzler, T. Strohman, Search Engines: Information Retrieval in Practice, AddisonWesley, 2009 (available at http://ciir.cs.umass.edu/irbook/).
4. R. Baeza-Yates, B. Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley, 2011 (2nd Edition).

Subject Name: Social Network Analysis					
Paper Code: CSEN6138					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. Students should be able to demonstrate basic knowledge of social networks and related application-oriented models.
2. Students should be able to understand applications of graph algorithms in social networks.
3. Students should be able to write programs to implement the related social network analysis algorithms when necessary.
4. Students should be accustomed to various network related libraries (in Python/Java/R/C++) to implement social network theories.
5. Students will get an exposure to the present state-of-the-art algorithms and methods in the area of social networks.
6. Exposure to the state-of-the-art algorithms should help the students in pursuing research in areas related to social networks.

Module I. Introduction [9L]

Motivating challenges in analysing social networks. (1L)

Measures and Metrics (4L): Degree centrality, Eigenvector centrality, Katz centrality, PageRank, hubs and authorities (HITS), closeness centrality, betweenness centrality, groups of vertices, transitivity, reciprocity, signed edges and structural balance, similarity, homophily and assortative mixing

Large Scale Structure of Networks (4L):

Components, shortest paths and the small world effect, degree distributions, power laws and scale-free networks, distributions of centrality measures, clustering coefficients

Module II. Random Networks [9L]

Understanding mean number of edges, mean degree, degree distribution, clustering coefficient, giant component, small components, and average path lengths for the following models-

Erdos-Renyi Network (3L); Small-world networks and Watts-Strogatz model (3L); Preferential attachment and Barabasi-Albert model (3L)

Module III. Propagation of Information in Netowrks [6L]

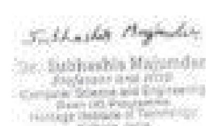
Contagion Models (3L): Models of disease spread – SI, SIS, SIR, SIRS and related literature. Outbreak detection.

Influence Maximization (3L): Influence spread models - independent cascade model, linear threshold model. Maximizing propagation of influence under different setups – greedy approximation algorithm by Kempe et. al. and related literature.

Module IV. Community Detection [12L]

What is a community? Notion of disjoint and overlapping communities. Goodness measures – modularity. Benchmarks and comparing with the benchmarks (F-measure, NMI, Omega index) (2L)

Strength of weak ties and related models. (1L); Clique Percolation model (1L); Modularity maximization, Clauset-Newman-Moore (CNM) method, Louvain Method (3L); Label propagation algorithm and its variants (2L); Random walks, Entropy-based method: Infomap (2L); Community preserving sparsification of social networks (1L)



Text Books :

1. Networks: An Introduction by Mark Newman. Oxford University Press.

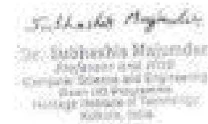
Reference Books :

1. Networks, Crowds and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg.

Dissertation Phase I   CSEN 6195

The students should be able to recall the concepts they have learned to implement in the Project .

They may work on some Analytical Model or do some Analysis for Decision Making process.



Students should be able to study thoroughly understand and propose a Design model for the problem

they like to undertake .

They should go through some literature reviews and try to come up with an Idea to implement their proposed work within given time .They should be able to apply the concepts they learned .

Students may also have exposure to the latest research and try to contribute there for their final year projects.

Dissertation Phase II   CSEN 6295

The students should be able to understand the Models under the Domain of their Study. Students should be able to study thoroughly and propose a Design model for the problem undertaken.

They should be able to apply the knowledge they have gathered from the M.Tech courses undertaken .

They should be able to create some Analytical Model or do some Analysis for Decision Making process. Come up with Applications/solutions.

<u>Second Year Syllabus</u>

<u>(M.Tech, ECE)</u>

Second Year, First Semester:

Course Title: Remote Sensing and applications					
Course Code: ECEN 6131					
Contact Hours/week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

CO

After going through this course, the students will be able to

1. Apply previously gathered knowledge on Electromagnetic Theory and Microwave Engineering to appreciate this subject.

2. Understand the basics of remote sensing principles and technologies and various remote sensing systems.

3. Acquire knowledge about the various remote sensing techniques for applications in improving social, economic and environmental conditions for agricultural, forestry and water body management

4. List various Remote Sensing missions worldwide

5. Analyze the operation of various remote sensing devices

6. Categorize the role of the Indian remote sensing program to explore possibilities in further studies and research.

Syllabus

Module I: Introduction to Remote Sensing. Development of remote sensing technology and advantages. EM spectrum, thermal emission and solar refection remote sensing. Interaction of EM radiation including atmospheric scattering, emission and absorption Atmospheric windows, spectral signature of various land cover features. (6L)

Variation of earth's reflectivity with angle of incidence, wavelength and geographical location; seasonal variation of reflectivity, solar radiation reflected from Earth. Thermal emission from cloud, raindrops, snow and fog. Radio noise and interference (6L)

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module 2: Basics of Remote sensing using Satellites. Sensors and cameras, Active, passive and ground based remote sensing. Introduction to Indian Remote Sensing Systems. Concepts of Thematic mapping. Microwave and Millimeter wave radiometers, Scanning systems, Scatterometer, Altimeters. (6 L)

Module 3: Satellite based remote sensors, space based remote sensors. Application of Remote Sensing in India, IRS Satellites, NOAA series, UARS (Upper atmosphere Research Satellites), TRMM (Tropical Rainfall Measuring Mission) (4L)

Module 4: Remote Sensing Technologies: spectral , spatial and temporal resolution. microwave sensing of sea surface, FOV(field of view),Radiation Principles (Plank's and Stephen Boltzman Law) (6 L)

Remote Sensing systems: LIDAR, SODAR, AURA MLS, Megha Tropiques. wind speed, water vapor and trace gas measurement. Recent and future trends . Research areas and insight into scopes and facilities in India (4 L)

Total : 32 Lectures.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Books:

1. Remote Sensing : Basudeb Bhatta (Oxford University Press)
2. Remote Sensing of Environment : Jenson (Pearson)

Course Title: Internet of Things (IoT) and applications					
Course Code: ECEN6132					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

At the end of the course, the students will acquire the following.

1. Understand different protocols.
2. Analyze IoT architecture.
3. Design applications based on IoT.
4. Create sensor based applications.
5. Develop new applications.
6. Compare different IoT uses.

Pre-requisite: Wireless Communication, Networking Concepts, Cellular/ WAN System

MODULE I : (10 L)

Introduction to IoT,
M2M to IoT- the vision, perspective, architectural overview, M2M & IoT fundamentals.

MODULE II : (10 L)
IoT architecture, state-of- the-art standards,
IoT reference models- domain model, information model, functional model, communication model.

MODULE III : (8 L)
Safety, privacy, security models, sensors and networks, interfacing for IoT, introduction to Python language

MODULE IV : (8 L)
Engineering applications- V2V, Industrial IoT, uses in healthcare, agriculture sectors

HOD, ECE Department
Heritage Institute of Technology
Kolkata

References:

1. Internet Of Things: Converging Technologies For Smart Environment And Integrated Ecosystems - Vermesan, Ovidiu, Fries, Peter - River Publishers, 2013
2. Internet Of Things Applications: From Research And Innovation To Market Deployment - Vermesan, Ovidiu, Fries, Peter- River Publishers, 2014
3. Python Programming For Teens - Lambart, Kenneth A. CENGAGE Learning, 2014
4. Understanding Smart Sensors - Frank, Randy, Artech House,2013
5. Learning Internet Of Things - Peter Wahar- Publisher PACKT - Amazon.In

Course Title: MIMO Systems					
Course Code: ECEN6133					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Outcomes:

At the end of the course, the students will acquire the following.

1. Explain the behavior of wireless communication.
2. Compare different channel models and MIMO channel model.
3. Calculate the capacity of MIMO communication systems.
4. Explain the diversity performance of MIMO channels.
5. Understand different coding schemes.
6. Design systems with multi-user MIMO communications.

MODULE I : (8 L)

Introduction to wireless communication systems and wireless channels.

MODULE II : (10 L)

Wireless channel models.

MIMO channel model.

MODULE III : (10 L)

Information Theory basics for MIMO communication.

Capacity of MIMO Communication systems.

Diversity performance of MIMO channels.

MODULE IV : (8 L)

Space Time Coding schemes.

Multi-user MIMO communications.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

References:

1. Principles of Mobile Communications by G. Stuber, Springer, 2nd ed..
2. Wireless Communications by A. Goldsmith, Cambridge
3. Space Time Coding, by Jafarkhani, Cambridge
4. OFDM for Wireless Communications by R. Prasad, Artech House, 2004
5. Adaptive PHY-MAC Design for Broadband Wireless Systems by R. Prasad, S. S. Das and Rahman, River Publishers

Course Title: **Design of Embedded Systems**					
Course Code: **ECEN 6122**					
Contact Hrs per week	L	T	P	Total	Credit Points
	3	0	0	**3**	**3**

COURSE OUTCOMES:

1. Students will learn Embedded System Design Methodology
2. Students will learn Embedded Processor Design
3. Students will learn 8051 Micro-Controller
4. Students will learn Embedded Memory and I/O Device interface
5. Students will learn Real time OS
6. Students will learn ARM Micro-Controller and PIC Micro-Controller

MODULE I: INTRODUCTION TO EMBEDDED SYSTEMS: [8L]

Embedded systems overview with various type of examples in different domains such as in communication systems, robotics application and in control application, Design challenge – optimizing design metrics, embedded processor technology, Difference between embedded computer systems and general purpose computer Systems, Design methodology.

MODULE II: EMBEDDED SYSTEM PROCESSOR DESIGN: [10L]

Custom single-purpose processors design: using finite state machine model and RTL model. Standard single- purpose processors design: Timers, and watchdog timers, LCD controller. Interfacing of Embedded Processors: Hardware protocol basics, interfacing with a generalpurpose processor, RS232, I2C, CAN protocol.

MODULE III: INTRODUCTION TO 8051 MICROCONTROLLER: [10L]

8051 architecture, pin configuration, I/O ports and Memory organization. Instruction set and basic assembly language programming. Interrupts, Timer/Counter and Serial Communication in 8051, Introduction to PIC and ARM micro-controllers.

MODULE IV: INTERFACING WITH MEMORY AND I/O DEVICES: [8L]

Different types of embedded memory devices and interfacing: SRAM, DRAM, EEPROM, FLASH, CACHE memory. Different types of I/O devices and interfacing: Keypad, LCD, VGA. Square wave and pulse wave generation, LED, A/D converter and D/A Converter interfacing to 8051.

TEXT BOOKS:

1. Embedded System Design: A Unified Hardware/Software Approach – 2nd Ed. by Ed Frank Vahid and Tony Givargis
2. Embedded Systems: A Contemporary Design Tool by James K. Peckol
3. Embedded / Real-Time Systems: Concepts, Design and Programming by K.V.K. Prasad
4. Embedded Systems by Raj Kamal

REFERENCE BOOK:

1. Computers as Components: Principles of Embedded Computing System Design – 2nd Ed. by Wayne Wolf.

Course Title: Design And Technology For Photonic Integrated Circuit					
Course Code : ECEN 6125					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Objectives:

1. Students will be able to solve problems associated with wave propagation through anisotropic mediums.
2. Students will be able to design different components such as planar and rectangular waveguides, bends, Y- section, couplers, filters etc.
3. Students will be able to design coupled waveguides and resonators.
4. Students will be able to design photonic band-gap devices.
5. Students will understand the fabrication process for different optical devices.
6. Students will be able to characterize the basic photonic components using simple python coding

Module 1: Introduction (12L)

Importance of photonic integrated circuit. **Components and materials for photonic integrated circuits**. **Review of EM wave propagation;** isotropic medium, wave impedance, Poynting vector, polarisation, reflection. **Electromagnetic properties of materials;** Lorentz oscillator model, Lorentz model for dielectrics, Kramers-Kronig relation, Drude model for metals. **Anisotropic medium;** dispersion, phase and group velocity, index ellipsoids, polarisation, optical axes.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module 2: Optical waveguide (8L)

Planar waveguides; TE and TM Modes, propagation constants, field distribution, dispersion equation. **Rectangular waveguide;** basic equation, dispersion relation, Kumar's method, effective index method. **Multimode interference (MMI) devices.**

Module 3: Coupled mode theory and applications (8L)

Coupled mode equations. Co directional and contra-directional couplers.
Derivation of coupling coefficients; slab waveguide and rectangular waveguide. **Interferometers;** Febry-perot, Mach-Zehnder. **Ring resonator. Bragg Gratings. Photonic band-gap devices;** periodic dielectric structure in two dimensions, square and honeycomb lattice, dispersion, wave guiding, directional coupler, left-hand propagation, self collimation.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Module 4: Fabrication and characterization (8L)

Materials, technology and process. Device fabrication flow; ion exchange-Glass, diffusion-LiNbO3 (dynamic device), etching -Silicon. **Numerical analysis using Python**; meshgrid, rectangles and the centering algorithm, bars and rectangles via linear meshgrids, lines & fills via linear meshgrids, circles & ellipses via Radial meshgrids, Pie Wedges via azimuthal meshgrids, Boolean operations.

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Text books:

1. Fundamentals of Photonics by **Bahaa E. A. Saleh, Malvin Carl Teich**
2. Theory of Optical Processes in Semiconductors: Bulk and Microstructure by **P. K. Basu**
3. Fundamentals of Optical Waveguides by **Katsunari Okamoto**
4. Waves and Fields in Inhomogeneous Media by **Weng Cho Chew**

Reference books:

1. Photonic Crystals: Molding the flow of light by **John D. Joannopoulos**
2. Silicon Photonics Design: From Device to Systems by **Lukas Chrostowski, Michael Hochberg**

Course Name: Nanomaterials and Nanotechnology					
Course Code : VLSI6131					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course outcomes:

At the end of the course the students would be able to:

1. Understand the basic science behind the design and fabrication of nano-scale systems
2. Gain knowledge regarding the structures of nanomaterials
3. Learn about the preparation of nanoparticles
4. Acquaint themselves with carbon nanotubes and porous materials
5. Understand and formulate engineering solutions for present-day problems and competing technologies for future applications
6. Gather detailed knowledge of the fabrication process.

Module 1: (9 lectures)

Introduction: Introduction to nanomaterials and nanotechnology, top-down and bottom-up methods of synthesis of nanomaterials, self-assembly, Structure of nanomaterials, synthesis of nanoparticles, homogeneous nucleation.

Module 2: (9 lectures)

Preparation of nanoparticles, carbon fullerenes, synthesis of nanowires, nanorods and nanotubes.

Module 3: (9 lectures)

Nanotubes: nanotubes of different materials, carbon nanotubes: graphene, SWNTs, MWNTs, structure of carbon nanotubes, carbon nanotube composite materials, carbon nanotube reactors.

Module 4: (9 lectures)

Porous materials and nano-lithography: classification of pores, synthesis of porous materials, photolithography, soft-lithography, DPN on various materials, toxic effects of nanomaterials.

Books:

1) Introduction to Nanotechnology Paperback – 2007 by Frank Owens Charles Poole – Wiley
2) Nanoscience and Nanotechnology: Fundamentals of Frontiers Paperback – 2013 , Shubra Singh M.S. Ramachandra Rao , Wiley
3) An Introduction to Nanomaterials and Nanoscience (PB) Paperback – 2005 , Das A , CBS Publishers

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Course Name: RF IC Design and MEMS Technology					
Course Code : VLSI6132					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

COURSE OUTCOMES:
Students should be able to:

1. Specify noise and interference performance metrics like noise figure, IIP3 and different matching criteria.
2. Comprehend different multiple access techniques, wireless standards and various transceiver architectures.
3. Design various constituents' blocks of RF receiver front end.
4. Describe MEMS fabrication technologies.
5. Critically analyze micro-systems technology for technical feasibility as well as practicality.
6. Comprehend the working of various systems and design electronic circuits for various applications.

Module I: [10L]
Prerequisite: RFIC design tradeoffs; Fading,Diversity; Multiple Access Schemes; S and ABCD parameters; Resonance in LC circuit; Concept of transmission lines-Reflection Coefficient; Impedance transformation and matching.
Unit1: RF Devices: Design of RF passive devices- capacitor, inductors; Design of RF MOS devices; Spectre RF ,BJT, MOS spice modeling in RF.
Unit2: RF Systems basics: Nonlinearity in RF Systems; IIP3, SFDR; Classical two port network theory of Noise; Noise in MOSFETs; Testing of RF System – Noise, Distortion Measures and Mitigation Methods.

Module II: [12L]
Unit1: RF System Blocks: Wideband amplifier design; LNA Design; Mixer Design, Gilbert mixer; Linearization techniques; Design Overview of oscillator and Mixer, Frequency Synthesizer; VCO design; power amplifier design – A,B,AB,C,D,E,F;
Unit2: Transmitter Architecture- PLL/CDR Loop, Frequency Divider Unit2: Receiver architectures- direct conversion, heterodyne, image reject architectures; Unit3: Applications- GSM,CDMA architectures.

Module lll: [9L]
Unit1: Introduction to MEMS technology: Basics of MEMS; Areas of application; Silicon as Design material; Important Material Properties and Physical Effects;Other design materials (GaAs,Quartz, SiC, Polymer etc.,)
Unit2: MEMS Fabrication: Bulk micromachining; Surface micromachining; Different types of etchants and etching methods; Nonlithographic Microfabrication Technologies

Module IV: [9L]
Unit1: MEMS Structures and Systems for sensors and actuators: Sensing and Actuation methods; Sensors of different types with example of each type (Mechanical, temperature, chemical , Lab on Chip, microfluidic, bio-sensors);micro pump; 3D Accelerometer, Digital Light Projector
Unit2: MEMS structure and systems for RF applications: Passive Electrical Components: Capacitors and Inductors; Surface-Micromachined Variable Capacitors;Bulk-Micromachined Variable Capacitors ;Micromachined Inductors; Microelectromechanical Resonators; Microelectromechanical Switches
Books:
1)MEMS- Fundamental Technology and Applications, Edited by Vikas Choudhury, CRC Press
2) MEMS Based Circuits and Systems for Wireles Communication, Christian C. Enz, Andreas Kaiser (Editors), Springer
3) RFIC and MMIC design and Technology, Edited by Robertson and S.Lucyzyn, IET publishers

HOD, ECE Department
Heritage Institute of Technology
Kolkata

Subject Name: BIOSIGNAL AND BIOMEDICAL IMAGE PROCESSING					
Paper Code: AEIE6121					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

COURSE OUTCOMES:

On completion of this course you should be able to:

1. Understand acquisition, general properties and clinical applications of biomedical signals such as ECG, EEG, EMG, EP and speech signal.
2. Learn the fundamentals of different modes of 2D and 3D medical imaging, including fluoroscopic, ultrasound imaging, computed tomography and magnetic resonance imaging.
3. Demonstrate advanced knowledge of filtering, transforms and spectral analysis of biomedical signal and images.
4. Apply image processing techniques for enhancement, filtering, segmentation and registration biomedical images.
5. Gain skill set to compress biomedical signals and images using loss less and lossy compression techniques as well as modern compressed sensing technique.
6. Perform signal analysis and classification using PCA, ICA, LDA, Bay's classifier, KNN and k-means clustering algorithm.

MODULE I – [8L]

Acquisition, General Properties and Clinical Applications of Biomedical Signals and their signal processing aspects:

Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Evoked Potential (EP)and Speech Signals.

Physics, Signal Processing and Clinical Applications of major modalities for medical imaging: Ultrasound, X-ray, CT, MRI, PET, and SPECT.

MODULE II – [10L]

Fundamentals of Biomedical Signal and Image Processing Techniques:

Signal acquisition- Sampling in time, aliasing, quantization, interpolation and noise; Convolution, Correlation and Covariance of signals.

Signal Transform: Discrete Fourier transform (DFT) and its properties, the fast Fourier transform (FFT), Short Time Fourier Transform (STFT), Time-Frequency analysis- Continuous wavelet transform and discrete wavelet transform, Discrete Cosine Transform (DCT)- Application of these transforms and examples with MATLAB.

Digital Filters: FIR and IIR digital filters design criteria, signal averaging; MATLAB implementation. Spectral Analysis: Nonparametric Estimators of PSD and Parametric Estimators.

MODULE III – [9L]

Medical Image Processing Techniques:

Extension of filtering and Transforms methods to 2-D signals and systems.

Image enhancement, Image Registration, Image Segmentation-pixel based, region based, edge based and morphological methods of segmentation with example in MATLAB.

MODULE IV – [9L]

Emerging topics:

Biomedical Data Compression- Need for data compression, Lossless and lossy compression, Compressive Sensing Algorithms– Sampling, representation and reconstruction for Signal and Image Processing Applications.

Multivariate Analyses: Principal Component Analysis and Independent Component Analysis.

Classification: Bayes' rule, detection, statistical classification, Linear Discriminant Analysis (LDA), Cluster Analysis- K-means clustering, K-nearest neighbour (KNN) classifier; Evaluation of classifier performance.

REFERENCES:

1. J. L. Semmlow and B. Griffel, Biosignal and Medical Image Processing, 3rd Eds., 2014.
2. J. L. Semmlow, Biosignal and Medical Image Processing: MATLAB based Applications, Marcel Dekker, Inc., Yew York, USA, 2004.
3. Amine Naït-Ali (Ed.), Advanced Biosignal Processing, Springer, 2009.
4. H. Liang, J. D. Bronzino and D. R. Peterson (Eds.), Biosignal Processing- Principle and Practices, CRC Press, 2013.
5. K. J. Blinowska, J. Zygierewicz, Practical Biomedical Signal Analysis Using MATLAB, CRC Press, 2012.

SUBJECT NAME: INTELLIGENT CONTROL					
Paper Code: AEIE6122					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

COURSE OUTCOMES:

After the completion of the course, the students will be able to:

1. Explain the concept of intelligent control and their applications.
2. Learn basics of Neural Network and control systems based on it.
3. Gain knowledge about fuzzy set theory and control scheme based on it.
4. Apply Genetic Algorithm to solve optimization problems in different control systems.
5. Provide detailed theoretical and practical aspects of intelligent modeling, optimization and control of non-linear systems.
6. Design Neural Network based predictor of nonlinear system.

MODULE I – [10L]

Introduction to Intelligent Systems and Neural Networks:

Introduction and motivation, Approaches to intelligent control, Architecture for intelligent control, Expert systems. Artificial Neural Networks: Concept of ANN and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feedforward multilayer perceptron. Learning and training of the neural network, Adaptive learning rate, weight update rule, Radial basis function networks.

MODULE II - [10L]

Fuzzy Logic and Model Based Fuzzy Control:

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self organizing fuzzy logic control. Fuzzy logic control for nonlinear time- delay system.

MODULE III - [8L]

Evolutionary Computation Techniques:

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters, Evolutionary design of controllers. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search and simulated annealing techniques for solving optimization problems.

MODULE IV - [8L]

Hybrid Computing Technique:

Neuro-Fuzzy Hybrid System, Adaptive Neuro-Fuzzy Inference System, Genetic Neuro Hybrid System, Genetic Fuzzy hybrid and Fuzzy Genetic hybrid system, Applications in system identification and control.

Introduction to Quantum Computation: Quantum neural network for fuzzy classifier, Quantum Neuro-Fuzzy classifier.

REFERENCES:

1. Y.C. Shin and C. Xu, Intelligent Systems: Modeling, Optimization and Control, CRC Press, 2008.
2. Kazumi Nakamatsu and Roumen Kountchev Eds., "New Approaches in Intelligent Control- Techniques, Methodologies and Applications", Springer, 2015.
3. Michael Negnevitsky, "Artificial Intelligence : a Guide to Intelligent Systems", Addison Wesley, 2005.
4. Robert E. King, "Computational Intelligence in Control Engineering", Control Engineering Series.
5. Marzuki Khalid, "Artificial Intelligence : Fuzzy Logic Module", University Technology Malaysia.
6. Marzuki Khalid, "Artificial Intelligence : Artificial Neural Networks Module", Universiti Teknologi Malaysia

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Detailed Syllabus
M. Tech. in Applied Electronics and Instrumentation Engineering (AEIE)
2nd Year –1st Semester

Subject Name: MICRO-ELECTROMECHANICAL SYSTEM DESIGN					
Paper Code: AEIE6131					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I: [5L]

Overview of Microsystems Design:
Glimpses of Microsystems; Typical MEMS and Micro-system products, Evaluation of Micro-fabrication, Micro systems and Micro-electronics; The multidisciplinary nature of micro system design and manufacturing; Applications of Microsystems in Automotive, health care, aerospace, telecommunication industries.

Module II: [10L]

Engineering Mechanics for* Micro-system *Design:
Static bending of thin plates: Bending of circular plates with edge fixed, Bending of rectangular plates with all edge fixed, Bending of square plates with all edge fixed; Mechanical Vibration: General Formulation, resonant Vibration, Micro-accelerometers, Design Theory of accelerometers, Damping coefficient, Resonant Micro-sensors; Thermo Mechanics: Thermal effects on mechanical strength of materials, creep deformation, thermal stresses; Overview of Finite Element Method.

Module III: [11L]

Microfluidic System Design:
Introduction to Fluid Mechanics: Viscosity of fluids, Streamlines and Stream Tubes, Control Volumes and control surfaces, Flows patterns; Basic Equations in Continuum Fluid Dynamics: Continuity, momentum equations and equations of motion; Laminar Fluid Flow in Circular Conduits: Computational Fluid dynamics; Incompressible Fluid Flow in Microconduits: Surface Tension, Capillary Effect, Micro-pumping; Heat Conduction Mechanics- Fourier Law of Heat Conduction, Heat conduction Equations with Cooling Law, Solid-Fluid Interaction, Boundary Conditions.

Module IV: [10L]

Microsystems Design:
Design Considerations: Constraints of Design, Material Selection, manufacturing process selection, Signal Transduction Selection, Electromechanical System, Packaging; Process Design: Photo-Lithography, Thin film Fabrications, Geometry Shaping, Mechanical Design: Thermo-mechanical loading, Thermomechanical Stress Analysis, Dynamic Analysis, Interfacial Facture Analysis, Mechanical Design Using Finite Element Method: Finite element Formulation, Simulation of Micro-fabrication Process; Design of Silicon Die for a Micro-pressure Sensor.

References:

1. G.T.A. Kovacs, *Micromachined Transducers Sourcebook*, WCB McGraw-Hill, 1998.
2. J.W. Gardner, *Microsensors: principles and applications*, John Wiley & Sons, 1994.
3. M. Madou, *Principles of Microfabrication*, CRC Press, 1998.
4. Kubby, *A Guide to Hands- on MEMS Design and Prototyping*, Cambridge,2011
5. *MEMS and Nanotechnology*, Volume 6: Proceedings of the 2012 Annual Conference on Experimental and Applied Mechanics: 42 (Conference Proceedings of the Society for Experimental Mechanics Series), Gordon A. Shaw (Author, Editor), Barton C. Prorok (Author, Editor), LaVern A. Starman, Kindle Edition, 2012.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Learn the significance of mechanical characteristics varies that with design.
2. Design MEMS-based diaphragm type devices analytically.
3. Fabricate the whole MEMS system with the help of simulation software.
4. Develop micro-fluidic system for biomedical applications.
5. Gain knowledge to design with finite element method based simulation process.
6. Develop skill on engineering mechanics for micro-system design.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Course Name: VLSI TECHNOLOGY					
Course Code : AEIE6132					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Module I- [11L]
Digital VLSI Circuits & Physical Layout:

MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Logical Effort, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop, Pseudo NMOS Logic, Dynamic gate, Domino and NORA Logic.
CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm, Layout Legging.

Module II- [9L]
VLSI Design Methodology:
Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node, VLSI Design Cycle, Y-Chart, Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX.

Module III-[8L]
Hardware Description Language:
Introduction to HDL and VHDL/Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed Mode combinational and sequential circuits with various examples, FSM Example: Mealy Machine and Moore Machine.

Module IV- [8L]
Analog VLSI Circuits:
Basic building blocks of Analog VLSI Chips, Analog VLSI Design Steps, MOS switch, MOS Diode, MOS Resistor, CMOS Current Source/Sink, Active Load, Voltage Dividers, CMOS Current Mirror, CMOS Cascode Current Sink and Current Mirror, CMOS Voltage Reference / Bandgap Reference.
CMOS Differential Amplifiers with passive and active load, Differential Gain, Common Mode Gain, CMRR, Ideal OPAMP, 2 Stage CMOS OPAMP, Switched Capacitor Filter and Integrator.

References
1. Neil Weste and Kamran Eshraghian, *Principles of CMOS VLSI Design, A Systems Perspective*, Addison Wesley, 2nd Edition, 2000.
2. Phillip E. Allen and Douglas R. Holberg, *CMOS Analog Circuit Design*, 2nd Ed., Oxford.
3. Sung-Mo Kang and Yusuf Leblebici, *CMOS Digital Integrated Circuits, Analysis and Design*, Tata McGraw Hill, 3rd Edition, 2006.

4. Neil Weste, David Harris and Ayan Banerjee, *CMOS VLSI Design, A Circuits and Systems Perspective*, 3rd Ed., Pearson, 2011.
5. M. Rabaey, *Digital Integrated Circuit- Design Perspective*, Prentice-Hall.
6. Angsuman Sarkar, Swapnadip De and Chandan Kumar Sarkar, *VLSI Design and EDA Tools*, Scitech Publications (India) Pvt. Ltd., 2011.
7. Behzad Razavi, *Design of Analog CMOS Integrated Circuits*, McGraw Hill.
8. J. Bhasker, *A VHDL Primer*, Prentice-Hall, 2013.

Course Outcome:

After the completion of the course, student will be able to:

1. Analyze CMOS digital electronics circuits including logic components and their interconnection.
2. Develop models of moderately sized CMOS circuits that realize specified digital functions.
3. Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects.
4. Learn VLSI design methodologies - the various steps and tools, the implementation choices, and good architecture practices.
5. Explain the fundamental principles of analog VLSI circuits.
6. Design models of moderately sized analog VLSI circuits for specified analog computing.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Subject Name: ROBOTICS ENGINEERING					
Paper Code: AEIE6133					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

Module I [8L]

Introduction to robotics, applications, elements of robots:
Introduction – progressive advancement in robots, laws of robotics, robot anatomy- links, joints, degree of freedom, manipulator and end effectors.
Industrial applications- material handling, processing, assembly, inspection; robot safety, non-industrial applications.

Module II [10L]

Direct and inverse kinematic model of robots:
Direct kinematic- description and structure of components, direct kinematic modeling of the manipulator, Denavit-Hartenberg (D-H) notation, kinematic relationship between adjacent links and manipulator transformation matrix, kinematic model examples.
Inverse kinematic- inverse kinematic technique, solvability of inverse kinematic model, inverse kinematic model examples.

Module III [9L]

Static and dynamic analysis of robot manipulators:
Manipulator differential motion and statistics- linear and angular velocity of a rigid body, relationship between transformation matrix and angular velocity, mapping of velocity vector and velocity propagation along links.
Dynamic modeling- Lagrangian mechanics, dynamic model of two degree of freedom manipulator.

Module IV [9L]

Robotic sensors and control of manipulators:
Robotic sensors- kinds of sensors used in robotics, industrial applications of vision – controlled robotic systems.
Control of manipulators- linear control schemes, characteristics of second order linear systems, partitioned PD control scheme, PID control, hybrid control, applications.

References:

1. A. Ghosal, *Robotics: Fundamental Concepts and Analysis*, Oxford University Press, 2nd reprint, 2008.
2. K. Fu, R. Gonzalez and C.S. G. Lee, *Robotics: Control, Sensing*, Vision and Intelligence, McGraw- Hill, 1987.

3. R.D. Klafter, T. A. Chimielewski and M. Negin, *Robotic Engineering – An integrated approach*, Prentice Hall of India, New Delhi, 1994.
4. Nagrath and Mittal, *Robotics and Control*, Tata McGraw- Hill, 2003.
5. Spong and Vidhyasagar, *Robot Dynamics and Control*, John Wiley and sons, 2008.

Course Outcomes:

After the completion of the course students will be able to

1. Explain robot anatomy by identifying its different components.
2. Know the potential area of application of robot.
3. Formulate direct and inverse kinematics model of robots for different degree of freedom robot manipulators.
4. Perform static and dynamic model analysis of robot manipulator.
5. Understand the applications of vision-controlled robotic systems and find the proper sensors used in robotics.
6. Choose and apply proper control strategy for second order linear systems model.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

	SUBJECT NAME: REMOTE SENSING				
	Paper Code: AEIE6134				
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I – [8L]
Remote Sensing Foundations:
Introduction to Remote Sensing: Definitions, Milestones in the History of Remote Sensing, Overview of the Remote Sensing Process, Key Concepts of Remote Sensing, Components of Ideal and Real Remote Sensing Systems, Advantages and Limitations of Remote Sensing, Remote Sensing data collection- Active and Passive Remote Sensing systems, Sensor Resolution- Spectral Resolution, Spatial Resolution, Temporal Resolution and Radiometric Resolution. Electromagnetic Radiation (EMR) Models- Wave model and Particle model, Interaction of EMR with the Earth surface- Reflection, Transmission, Spectral Signature; Energy-Matter Interactions with the Terrain- Scattering, Absorption, Refraction and Reflectance, Radiance and Irradiance.

Module II - [10L]
Image Acquisition and Photogrammetry:
Arial Photography, Flight lines, Flight planning; Thermal Infrared Remote Sensing; Active Microwave Imagery System- Components, wavelength, Frequency and Pulse Length, Azimuth and Range Direction, Depression Angle, Incident angle and Polarization, Slant-Range versus Ground-Range RADAR image geometry- Computation of Range and Azimuth Resolution, Radar Equation, Synthetic Aperture Radar System; Light Detection and Ranging (LIDAR); Photogrammetry- Scale and height measurement, Stereoscopic measurement of object height or Terrain Elevation, Area measurement.

Module III-[10L]
Essential Image Processing for Remote Sensing:
Introduction to monochromatic and colour Image, Image rectification and restoration – Radiometric correction, Geometric correction and noise removal; Image enhancement- Contrast manipulation, Spatial feature manipulation, Multi-image manipulation; Histogram modification, Image filtering- Concepts of convolution for image filtering, Low-pass filters (smoothing), Gaussian filter, The k- nearest mean filter, Median filter, Mode (majority) filter, High-pass filters (edge enhancement), Gradient filters, Laplacian filters, Edge-sharpening filters, Local contrast enhancement; Arithmetic operations - Image addition, subtraction (differencing), multiplication, Image division (ratio), Index derivation and supervised enhancement, Vegetation indices, Iron oxide ratio index, TM clay (hydrated) mineral ratio index.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Module IV-[8L]

Remote Sensing Data Classification and Analysis:

Machine learning techniques of remote sensing data analysis- challenges, General concept of machine learning- Unsupervised classification, Supervised classification; Paradigms in remote sensing-feature extraction and selection, Classification, Clustering; Unsupervised classification - Iterative clustering algorithms; Supervised classification- Bayesian classification strategy, Introduction to Neural Networks and Support Vector Machines (SVM), Decision rules: dissimilarity functions; Post-classification processing- smoothing and accuracy assessment, Classification accuracy assessment.

References:

1. John R. Jensen, *Remote Sensing of the Environment: An Earth Resource Perspective*, Prentice Hall press, Second edition, 2007.
2. James B. Campbell and Randolph H. Wynne, *Introduction to Remote Sensing*, The Guilford Press, New York, Fifth edition 2011.
3. Thomas M. Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, *Remote Sensing and Image Interpretation*, Wiley, 2004.
4. George Dr. Joseph, *Fundamentals of Remote Sensing*, Universities Press; Second edition, 2005.
5. Basudeb Bhatta, *Remote Sensing and GIS*, Oxford, Second edition, 2011.
6. Jian Guo Liu and Philippa J. Mason, *Essential Image Processing and GIS for Remote Sensing*, Wiley-Blackwell, UK, 2009.
7. Robert A. Schowengerdt, *Remote Sensing: Models and Methods for Image Processing*, Academic Press, Elsevier Inc., Third edition, 2007.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Understand and describe the key theoretical components involved in the remote sensing data collection process such as, energy sources, energy-terrain-atmosphere interactions, platforms and sensor resolution characteristics spanning multispectral and hyperspectral.
2. Gain knowledge of thermal remote sensing, active microwave remote sensing such as RADAR, LIDAR and synthetic aperture RADAR.
3. Perform photogrammetric calculations such as scale factor, height, area, etc. from vertical aerial photographs.
4. Learn essential image processing techniques such as image enhancement, restoration and filtering of noise, etc.
5. Carry-out basic arithmetic operations and correction procedures such as geometric, radiometric and atmospheric corrections on image.
6. Acquire knowledge of machine learning techniques of remote sensing data analysis.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

	SUBJECT NAME: DISSERTATION PHASE I				
	Paper Code: AEIE6195				
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	20	20	10

Dissertation should be on any topic having relevance with Instrumentation, Electrical or inter-disciplinary field of engineering. The same should be decided by the student and concerned supervisor. Dissertation should consist of research work done by the student in the selected topic with comprehensive and significant review of recent developments in the same field.

Dissertation Phase I shall consist of the following division(s) whichever applicable:

1. Introduction
2. Aims and objective of the work
3. Extensive literature survey and evaluation of unsolved issue
4. Data collection from experimental set-ups, websites, R&D organizations, industries, etc.
5. Study of the viability, applicability and scope of the dissertation
6. Detailed design (hardware or software as applicable)
7. Partial implementation with results
8. Future work related to thesis

A candidate should prepare the following documents for examination:

1. A detailed report in the prescribed format based on the work related to dissertation.
2. Every candidate should present himself (for about 20-30 min.) for evaluation before the panel of examiners consisting of Head of Department, M. Tech. Coordinator, Supervisors and examiners from outside of the department.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Demonstrate ability to identify and formulate real world engineering problems relevant to society needs; study its feasibility and methodology for implementation.
2. Apply knowledge of circuit design, sensor selection, signal processing, artificial intelligence, intelligent control system, embedded system and programming, etc., to implement the project work with proper time frame.
3. Implement hardware model along with its relevant software programming, conduct experiments, analyze and interpret data and explain them.
4. Prepare project report properly and demonstrate presentation confidently.
5. Develop regularity, engage in enduring learning and deal existing project ethically.
6. Build up interpersonal communication skill and demonstrate sound technical knowledge of their project work.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

Detailed Syllabus
M. Tech. in Applied Electronics and Instrumentation Engineering (AEIE)
2nd Year –2nd Semester

	SUBJECT NAME: DISSERTATION PHASE II				
	Paper Code: AEIE6295				
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	28	28	14

The Dissertation Phase II is an extension of Dissertation Phase I. It shall be assessed internally by a panel of examiners (similar to the one formed in dissertation Phase I) before submission to the Institute. The candidate shall submit the dissertation in triplicate in the prescribed format to the Head of the department/M. Tech coordinator, duly certified that the work has been satisfactorily completed.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Demonstrate ability to identify and formulate real world engineering problems relevant to society needs; study its feasibility and methodology for implementation.
2. Apply knowledge of circuit design, sensor selection, signal processing, artificial intelligence, intelligent control system, embedded system and programming, etc., to implement the project work with proper time frame.
3. Implement hardware model along with its relevant software programming, conduct experiments, analyze and interpret data and explain them.
4. Prepare project report properly and demonstrate presentation confidently.
5. Develop regularity, engage in enduring learning and deal existing project ethically.
6. Develop interpersonal communication skill and demonstrate sound technical knowledge of their project work.

Heritage Institute of Technology
Department of Applied Electronics & Instrumentation Engineering

	SUBJECT NAME: COMPREHENSIVE VIVA VOCE				
	Paper Code: AEIE6297				
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	0	0	2

Every student should appear before a panel duly constituted by the members of internal faculties of the department in order to evaluate his/her knowledge in various subjects learned during the two years of study of the M. Tech AEIE course.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Answer questions from all the courses studied.
2. Attain Oral Presentation skills by answering questions in precise and concise manner.
3. Appear interview elegantly and confidently.
4. Develop habits of learning.

Subject Name: Renewable Energy Resource and Characteristics					
Paper Code: REEN5101					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:

Upon completion of the course, students will have:

1. Ability to recognize the need of renewable energy technologies and their role in the India and world energy demand.
2. Ability to distinguish between the sustainable energy sources and fossil energy sources with emphasis on wind and photovoltaic systems.
3. Knowledge of the operating principles of geothermal heat pumps and principles of renewable energy production from various renewable sources, especially.
4. Ability to compare the advantages and disadvantages of various renewable energy technologies and propose the best possible energy conversion system for a particular location.
5. Knowledge of security and operational requirements of autonomous and net connected renewable energy systems.

Module 1: [10L]

World energy resources - Indian energy scenario - Environmental aspects of energy utilization; review of conventional energy resources - coal, gas, oil reserves and resources; Different form of non- conventional energy; Renewable energy resources and their importance – solar, wind, hydro, biomass, geothermal, and ocean energy, role of energy in economic development and social transformation; solar spectrum; electromagnetic spectrum, basic laws of radiation. A brief history of energy consumption; Energy flow in ecosystem; Fuel cells - types of fuel cells; thermodynamic efficiency of PEM fuel cell; Environmental impact of the PEM fuel cell in the transportation sector as compared to internal combustion engine.

Module 2: [10L]

Solar Energy: Solar radiation: Measurements and prediction; Solar energy conversion techniques to heat and electricity; Spectrum of electromagnetic radiation, sun structure and characteristics, Heat transfer processes applicable to solar energy, solar radiation, and its analysis; solar radiation characteristics of opaque materials and transmission through glazing. Natural convection case studies. Heat transfer in packed beds and perforated plates. Instruments for measurement of solar energy (Pyranometer / pyrheliometer / sunshine recorder), solar radiation on the collector; Introduction to solar cells; Relation between solar radiation spectrum and UV-vis & IR component.

Module 3: [10L]

Wind Energy: Wind Energy scenario in India & World. Power available in the wind. Wind speed and direction measuring instruments. Factors influencing global & amp; local wind circulation. Environmental benefits and problems of wind energy. Factors influencing the cost of wind energy. Wind energy conversion system (WECS): classification, characteristics, and applications. Betz limit. Tip speed ratio.

Hydropower: Hydropower scenario India & World. Classification of hydropower plants. Overview of micro, mini, and small hydro systems. Advantages and disadvantages of Hydropower. Head and Discharge measurement.

Module 4: [10L]

Biomass: Origin of biomass - plant derived, residues, aquatic, marine biomass, various wastes, photosynthesis; Biomass resource assessment - Estimation of woody biomass, non woody biomass and wastes, ASTM standards. Bulk chemical properties - Moisture content, proximate and ultimate analyses, calorific value, and waste water analysis for solids; Chemical composition of biomass - Cellulose, hemicelluloses and lignin content in common agricultural residues and their estimation, protein content in biomass; Structural properties - Physical structure, particle size and size distribution, permeability; Physical properties - Bulk density, angle of repose, thermal analysis (TGA, DTA, and DSC).

Ocean, Tidal, and Geothermal Energy: Ocean energy resources, ocean energy routes; principles of ocean thermal energy conversion systems; principles of ocean wave energy conversion and tidal energy conversion; Availability of geothermal energy-size and distribution; recovery of geothermal energy, various types of systems to use geothermal energy; Power generation using geothermal heat, Sustainability of geothermal source, Geothermal heat pump and geothermal energy scenario in India.

Text/Reference Books:

1. Garg H.P., Advances in Solar Energy Technology. D. Publishing Company, Tokyo, 1990.
2. Alan L.F. & R.H. Buse, Fundamentals of Solar Cells, Academic Press, London, 1983.
3. Khandelwal, K.C. &Mandi, S.S., Practical hands boo Biogas Technology, 1990.
4. Rai, G.D., Non-Conventional Energy Sources, Kh Publishers, New Delhi.
5. Mathur A.N. &Rathore N.S. Renewable Energy Sources, Bohra Ganesh Publications, Udaipur, 1992
6. Kothari, Renewable Energy Sources and Emerging Technologies, PHI, Eastern Economy Edition, 2012.
7. Bansal N. K., Kleeman M. K., Mells M. Renewable Sources of Energy and Conversion Technology, Tata McGraw-Hill, 1990.

Subject Name: Research Methodology and IPR					
Paper Code: REEN5103					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	**0**	**0**	**2**	**2**

Course outcomes:

1. The students will be able to understand research problem formulation.
2. The students will be able to analyze research related information.
3. The students will be able to Follow research ethics.
4. The students will be able to carry out research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
5. The students will be able to understand that when IPR would take such important place in growth of individuals & nation and its protection would provide an incentive to inventors for further Research and Development.

Module 1: [6L]

Introduction to research; Definitions and characteristics of research; Types of research;Main components of any research work.

Analysis and Statement of the problem: Learning Objectives; Analyzing the problem; Formulating theproblem statement.

Literature review: Uses of literature review; Source of information; Aims & Objectives, Formulation and Scheduling of Objectives; Definitions; of the research objectives. Basic Quality Management tools and Acceptance Sampling, Numerical Problems.

Module 2: [6L]

Development of Research Hypotheses, Data Collection — Primary and Secondary Data, Determination of Sample Size. Testing of Hypotheses, Null and Alternate hypothesis, One tailed and two –tailed test, Type I and Type II error, Steps in Testing Hypothesis, Basic concepts of Descriptive Statistics, Basic concepts of Design of Experiments. Numerical Problems.

Module 3: [6L]

Basic Spreadsheet tools: Introduction to spread-sheet applications, features & functions, using formulae & functions, data storing, features for statistical data analysis, generating charts/graphs & otherfeatures.

Basic Presentation tool: Introduction to presentation tool, features & functions, creating presentations Basic Concepts of Web Search: search engines using for research data bases, Basics of Thesis writing editing tools. Writing style of Reference and Nomenclature. Basics of IPR. Need for patent filing and its basic methodologies.

Text/ Reference Book:

1. Montgomary, Douglas C. Design and Analysis of Experiments, WileyIndia, 5/e, 2007.
2. Kothari C.K. Research Methodology – Methods and Techniques, NewAge International, 2/e,2004.
3. Krishnswamy, K.N., Shivkumar, AppaIyer and Mathiranjan M., Management Research Methodology; Integration of Principles, Methods and Techniques, Pearson Education, 2006.
4. Stephan L. Nelson, Gujulia Kelly, The Complete reference Office Xp, TMH, 2001.
5. University of Chicago Press, Chicago Manual of Style, University of Chicago Press, 2003.
6. Udpa, S. R., Quality Circles in India: Participation for Progress, TMH, 1988.
7. Chopra, S., A Book on Indian Patenting System, Notion Press, 2018
8. Ramakrishna, B. and Kumar, Anil, H. S., Fundamentals of IPR for Students, Notion Press, 2017

Subject Name: Material for Renewable Energy Application					
Paper Code: REEN5141					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:

1. To get familiarized with the properties of different materials- metals and nonmetals.
2. To learn about the manufacturing process of nano-material and its characterizations techniques.
3. Ability to design photovoltaic material and its electronic properties for the solar energy application.
4. Ability to understand the role of selection for the wind turbine material and it required properties.
5. To acquire knowledge on the characterization of materials by modern tools.

Module 1: [10L]

Nanomaterial for renewable energy: Classification of nanomaterials – zero-dimensional, one- dimensional, two-dimensional, three- dimensional; Synthesis of nanomaterials: Bottom up and top down approaches, colloidal method, chemical vapor deposition (CVD) methods, wet chemical methods, sol- gel synthesis, and mechanical exfoliation methods, physical vapor deposition (PVD), sputtering, plasma enhanced CVD (PECVD), hot wire CVD (HWCVD), Nano-structured materials with applications - quantum dots, nano-tubes, nano-wires, nano-crystals.

Module 2: [10L]

Materials for photovoltaic conversions, Si and non-Si materials, crystalline, semi crystalline, polycrystalline and amorphous materials; Nano, micro, and poly-crystalline Si for solar cells, mono- micro silicon composite structure; Technology for Si extraction, purification; Method of doping and junction fabrication; Cell fabrication and metallization techniques; Networking the PV cell; P-N junction, sources of losses and prevention, Concepts on high efficiency solar cells, tandem and multi- junction solar cells, photo-voltaic materials and photo-voltaic modules and their applications; Solar PV concentrator cells and systems, III-V, II-IV compound materials thin film solar cells.

Module 3: [10L]

Materials for wind turbines- blades, nacelles, and tower; Important properties of the blade, Metal and polymer-composite material for blade and tower; Rotor blade – properties and application; Erecting of the tower material, Support materials for wind tower, Corrosion issues; importance of nacelles in wind turbine and its component.

Mechanical properties: flexural strength, bending moment, strength of material- yield strength, ultimate strength, Young's modulus, Poisson's ratio, and fatigue; Universal testing machine (UTM); shear webs for wind turbine blades.

Module 4: [10L]

Electronic and atomic structures of solar cell material; Atomic bonding in solids, crystal structure, microstructure, solidification, alloys; Description of optical and thermal materials for solar cell application.

Material characterization: Scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD), Single crystal X-Ray diffraction, Ultraviolet visible spectroscopy, Raman spectroscopy, atomic force microscopy (AFM), and X-ray photoelectron spectroscopy (XPS); Pulse layer deposition (PLD), PV cell diode properties, PV cell series resistance, PV cell shunt resistance.

Text/Reference Books:

1. Rosa A. Fundamentals of Renewable Energy Processes, 3rd ed., 2012.
2. Martin A.G., Solar cells: Operating principles, technology and system applications, Prentice-Hall Inc, Englewood Cliffs, NJ, USA, 1981.
3. Rao C.N.R., Muller A. & Cheetham A.K. Nanomaterials Chemistry - Recent Developments andNew Directions, Wiley VCH, 2007.
4. Moller H.J. Semiconductor for solar cells, Artech House Inc, MA, USA, 1993.
5. Barbec C., Dyakonov V., Parisi J., Saricittci N.S. Organic photovoltaics: Concepts and realization, Springer-Verlag 2003.
6. Nijssen R.P.L. & Brondsted P. Advances in wind turbine blade design and materials, Elsevier,2013..

Subject Name: Modeling and Analysis of Renewable Energy System					
Paper Code: REEN5145					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:

1. Given an unconstrained optimization problem, students will be able to apply the correct optimization method to solve the problem.
2. Given a constrained optimization problem, students will be able to set up the objective function correctly and apply appropriate methods to solve the problem.
3. Given a power generation system, students will be able to apply appropriate optimization methods to determine the optimal scheduling of power generation and also will be able to find out the most economic load dispatch scheduling for power generating units.
4. Given a physical process, students will be able to identify the appropriate method to mathematically model the system to predict relevant variables.
5. Given a multivariable physical system, students will be able to apply regression methods to develop a statistical model for it.

Module 1: [10 L]

Essential features of optimization problems, General methods to solve optimization problems, continuity of functions, unimodal, multimodal, convex and concave functions; Concept of Hessian matrices; Unconstrained- Optimality conditions, Newton and quasi-newton methods of unidimensional search; multivariate search; Introduction to simple Constrained Optimization: Lagrange multipliers – Necessary and sufficient conditions for optimality; sensitivity analysis

Module 2: [10 L]

Least square method for linear regression; Levenberg Marquardt algorithm for non-linear regression; Multivariate first order regression**.** Introduction to Response Surface Methodology, the Method of Steepest Ascent, analysis of a second order model, location of the stationery point, characterizing the response surface, experimental designs for fitting response surfaces, applications and numerical problems.

Module 3: [10 L]

Initial value problems solution by Runge-Kutta Method. Concept of partial differential equation (PDE); Discretization in space and time; Implicit and explicit scheme; Finite difference: Crank-Nicholson method to solve parabolic PDE;

Module 4: [10 L]

Optimal power generation scheduling, economic load dispatch of power generating units; Multi

object-stochastic power dispatch-stochastic problem formulation; algorithm; application of the method.
Case studies of optimisation in Energy systems – problems.

Text/Reference Books:

1. Himmelblau D.M. & T.F. Edgar T.F., Optimization of Chemical Processes:, McGraw-Hill, 2001.
2. Kothari D. P. & Dhillon J.S. Power System Optimization, PHI, 2nd Edition, 2004.
3. Soliman S.A.H., Mantawy A.A.H., Modern Optimization Techniques with ApplicationsinElectric Power Systems, Springer, 2011.
4. Chung K L, Elementary probability theory with stochastic processes, Springer, 4/e, 2013.
5. Montgomery, Douglas C., Design and Analysis of Experiments, Wiley International StudentVersion 8/e, 2012.
6. Chapra S., Canale R., Numerical Methods for Engineers, McGraw Hill Education India PrivateLimited, 7th Edition, 1985.

Gilat A., Subramaniam V., Numerical Methods for Engineers and Scientists, John Wiley andSons, 3rd Edition, 2017

Subject Name: Measurement Analysis Laboratory					
Paper Code: REEN5151					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course outcomes:

1. Ability to characterize and analyse of liquid fuel property.
2. Ability to measure the insulating property of material.
3. Ability to operate various sophisticated analytical equipment.
4. Ability to determine energy efficiency of various process equipment.

Experiments:

At least any five experiments are to be carried out by students

1. Characterization of fuel (Measurement of Flash point, Fire point, Cloud point, Pour point etc.).
2. Determination of calorific value of fuel.
3. Analysis of moisture content and kinematic viscosity of fuel.
4. Measurement of energy consumption using energy meter.
5. Measurement of efficiency of fuel cell.
6. Determination of thermal conductivity of insulating materials.
7. Analysis of forced convection heat transfer.
8. Measurement of illumination using Luxmeter.
9. Solute concentration analysis of an aqueous solution using UV-Vis spectrophotometer.
10. Solute concentration analysis of a non-aqueous solution using GC analyser.

Subject Name: Solar Energy Engineering					
Paper Code: REEN5201					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:

1. Students will be able to characterize different modes of heat transfer with emphasis on solarradiation.
2. Students will be able to identify different technologies used for solar collectors.
3. Students will be able to evaluate the performance and efficiency of different devices that extractpower from solar energy.
4. Students will be able to explain the basics of solar PV cells and relevant parameters for itscharacterization.
5. Students will be able to explain the important features of first to third generation solar celltechnology.

Module 1: [10L]

Solar radiation: sun earth geometric relationship, solar angles, sun's trajectories in different seasons, zenith solar time, air mass, solar beam, total solar radiation & diffuse radiation, solar radiation on different surfaces at different angles, extraterrestrial radiation. Attenuation of solar radiation by the atmosphere, beam and diffuse components of hourly and daily radiation, clearness index.

Solar water heating; active and passive. Forced and natural circulation system. Solar process loads. Solar system thermal calculations; component models, collector heat exchanger factor and duct and pipe loss factors. System models. Collector models.

Module 2: [10L]

Flat plate collector, Liu & Jordan relation. Unglazed, Single and double glazed solar collectors, Optical losses and thermal losses, thermal analysis and performance characteristics.

Water and air heating collectors: their specific features. Evacuated tube collectors: characteristics, materials, thermal analysis.

Concentrating solar collectors: General description; concentrators, receivers, Orienting/tracking requirements, Materials General characteristics Optical features of solar concentrators. Optical and thermal losses, Thermal performance characteristics parabolic trough collectors (PTC), Parabolloid dish collectors, Scheffler dish, Linear Fresnnel Reflector Collector.

Module 3: [10L]

Introduction to Solar PV: Crystal structure, band theory, energy band diagrams, Fermi level, intrinsic and extrinsic semiconductor, doping, n-type and p-type silicon, p-n junctions, drift and diffusion current, absorption of radiation and excess minority carriers, generation, recombination and carrier separation Standard solar cell structure, I-V characteristics, FF, Voc, Isc, Pmax, conversion efficiency, losses in solar cell, Rs, Rsh, impact of radiation and temperature, PC1D simulation of industrial solar cell structure Concepts of heterojunctions, multi junction and concentrated solar cell.

Module 4: [10L]

First generation: Silicon wafer based technology: Materials and process requirements for solar cell fabrication, process flow, Single and poly crystalline silicon solar cells,

Second generation: Thin film technologies: Merits and demerits of thin film technologies, amorphous - Si, CdTe and CIGS solar cell module, manufacturing steps.

Third generation/emerging PV technologies: Organic PV, Dye sensitized PV, Materials and process requirements for module assembly, routine and type tests, qualification test standards, types of degradation

Text Books:

1. Sukhatme S. & Nayak J.: Solar Energy: Principles of Thermal Collection and Storage, ThirdEdition (Tata McGraw Hill, 2008).
2. Solanki C.S., Solar Photovotaics – Fundamentals, Technologies and Applications, (PHILearning).

Reference Books:

1. Sukhatme S.P., A Textbook on Heat Transfer, Fourth Edition, University Press India Ltd., 2005.
2. Goswami D.Y., Kreith F. & Kreider J.F., Principles of solar Engineering, Tyalor and Francis,Philadelphia, 2000.
3. Duffie J. A. & Beckman W.A., Solar Engineering of Thermal Processes, Third Edition, JohnWiley & Sons, 1974.
4. Kalogirou S.A., Solar Energy Engineering: Process and Systems, Academic Press, 2nd Edition,2014.
5. Würfel P., Physics of Solar Cells: From Basic Principles to Advanced Concepts, Wiley VCH,2009.

Subject Name: Technology for Renewable Power Generation					
Paper Code: REEN 5202					
Contact Hours	L	T	P	Total	Credit Points
Per Week	3	0	0	3	3

Course outcomes:

1. Students will be able to understand of design and evaluation solar thermal power plants.
2. Students will be able to develop a comprehensive technological understanding in solar PVsystem components.
3. Students will be able to get in-depth understanding of design parameters to help design andsimulate the performance of a solar PV power plant.
4. Students will be able to update themselves with the latest trends in wind turbine technology.
5. Students will be able to understand of power systems, their operation and control focused on theissues related to the integration of distributed renewable generation into the network.
6. Students will be able to understand geothermal and ocean thermal technologies.

Module 1: [10L]

Solar Thermal Power Generation:

Radiation optics. Second Law of thermodynamics for solar concentrators. Comparison of concentrators and flat plate collectors, Performance analysis and characteristics. Solar Parabolic trough: design considerations, thermal design of receivers. Thermodynamic cycle and solar plant. Solar thermal power plant, central receiver power plant, solar pond, solar air conditioning and refrigeration, solar kiln, solar cooker, solar greenhouse, overview on energy efficient building construction.

Module 2: [15L]

Solar PV power generation:

PV module technology: response to weather parameters, commercial module ratings, standards, module reliability.
Inverter technology: types of inverters, inverter selection, voltage levels, performance, power quality **Balance of system/plant:** Module mounting structure, tracking system, Cabling and electrical design, single line diagrams, metering Safety systems: Hotspot, Blocking and bypass diodes, surge protection, PID and its protection, Lighting protection, anti-islanding Rooftop PV plant: design consideration, types of mounting structures, standards Ground mounted PV plant: Array design and PV panel mounting, electrical layout, standards Performance parameter: Losses in solar PV power plant, Yield, Capacity Utilization Factor and Performance Ratio shadow analysis. Grid interactive solar PV power systems. Solar power plant using a satellite.

Module 3: [7L]

Wind Turbine Loads. Wind Turbine Rotor Dynamics. One-dimensional Momentum Theory and Betz Limit.

Blade Design for Modern Wind Turbines: Momentum Theory and Blade Element Theory. Introduction to Computational Aerodynamics in wind turbine design.

Module 4: [8L]

Other forms of renewable energy generation: Geothermal power generation.

Ocean power generation: Tidal energy estimation. Tidal power plant. Wave energy. Ocean Thermal Energy Conversion (OTEC). Power Generation from landfill gas, liquid waste.

Text/ Reference Books:

1. Kothari D.P., Singal K.C., Ranjan R. 'Renewable Energy Sources and Emerging Technologies'
   PHI Learning Pvt. Ltd, 2nd edition, 2013, New Delhi, India.
2. Sukhatme S.P. and Nayak J., Solar Energy: Principles of Thermal Collection and Storage, ThirdEdition (Tata McGraw Hill, 2008).
3. Solanki C.S., Solar Photovoltaics – Fundamentals, Technologies and Applications, 2nd ed. (PHILearning, 2011).
4. Balderas M.H., Renewable Energy Grid Integration, Nova Science Publishers, New York, 2009.

Subject Name: Hydrogen and Fuel Cell Technology					
Paper Code: REEN 5241					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. The objective of the course is to provide comprehensive and logical knowledge of hydrogenproduction, storage, and utilization. In addition,
2. Ability to demonstrate knowledge of renewable energy technology.
3. Able to understand the role of nanotechnology in energy conversion.
4. Provide an understanding of various fuel cell technologies.
5. To build knowledge to design nano-systems, component or process as per need andspecification.
6. To acquire knowledge layered Integration and performance for micro fuel cellsystems.
7. To acquire knowledge about the different types of fuel cell and their application.

Module 1: [10L]

Introduction of hydrogen energy systems: Properties of hydrogen as fuel, Hydrogen pathways introduction-current uses, general introduction to infrastructure requirement for hydrogen production, storage, dispensing and utilization, and hydrogen production plants.

Hydrogen production processes: Thermal-Steam reformation, thermo chemical water splitting, gasification-pyrolysis, nuclear thermal catalytic and partial oxidation methods. Electrochemical-Electrolysis, photo electro chemical, Biological-Anaerobic digestion, fermentation micro-organism, PM based electrolyser.

Module 2: [10L]

Hydrogen storage: Physical and chemical properties, general storage methods, compressed storage- composite cylinders, glass micro sphere storage, zeolites, metal hydride storage, chemical hydride storage and cryogenic storage, carbon based materials for hydrogen storage.

Hydrogen utilization: Overview of hydrogen utilization, IC Engines, gas turbines, hydrogen burners, power plant, domestic cooking gas, marine applications, hydrogen dual fuel engines.

Module 3: [10L]

Fuel cells: History – principle - working - thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison on battery Vs fuel cell, Types of fuel cells – Proton Exchange Membrane Fuel Cell, Molten Carbonate Fuel Cells, Acid Alkaline Fuel Cells, Direct Methanol, Solid Oxide Fuel Cells, Microbial Fuel Cells, Other non-hydrogen fuel cells, relative merits and demerits, Polarization curve- Activation loss, Ohmic loss, and Mass transport loss.

Module 4: [10L]

Applications of fuel cells: Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space, economic and environmental analysis on usage of hydrogen and fuel cell. Future trends in fuel cells, portable fuel cells, laptops, mobiles, submarines. Hydrogen safety: Hydrogen safety aspects, backfire, pre-ignition, hydrogen emission NOx control techniques and strategies, Hydrogen powered vehicles.

Subject Name: Industrial Energy Analysis					
Paper Code: REEN5243					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. Students will be able to perform material balance calculations for a specific problem.
2. Students will be able to carry out energy balance calculations for different operations.
3. Students will be able to estimate the energy consumed and suggest means for improving energyefficiencies for boiler and furnace operations.
4. Students will be able to analyze a fluid flow system to select a pump/blower/compressor andestimate the efficiency of the operation.
5. Students will be able to estimate efficiencies for electrical systems in industries e.g. heating,lighting and motors.
6. Given a small or medium sized industry, students will be able to suggest measures for improvingenergy efficiency.

Module 1: [10 L]

Concepts of basis; mole fraction, mass fraction; Material balance without reaction – applications in renewable energy systems; Recycle and bypass calculations; Basics of energy balance – calculation of enthalpy in systems without reaction from mean/temperature-dependent heat capacity data, calculationof heat of reaction and adiabatic reaction temperature in reactive systems; Examples on combined material and energy balances in industrial processes.

Module 2: [10 L]

Heat transfer equipment fundamentals; methods for improving thermal and flow efficiency in Heat-exchangers – selection of suitable material of construction for tubes, optimizing shell and tube pressure drops; Energy efficiency analysis in boilers and furnaces; heat recovery in waste-heat boilers; heat recovery systems for gas turbines; efficiency analysis of wind turbine systems.

Module 3: [10 L]

Energy efficiency of compression systems – basics of pumps, performance characteristics of centrifugal pumps, BEP in characteristic curve, analysis of series/parallel operation of centrifugal pumps, ways of avoiding cavitation; efficiency of fans and blowers; estimation of single stage and multistage compressor efficiency; estimation of piping losses; efficient design of piping networks by Hardy-Cross method.

Module 4 [10 L]

Efficiency analysis of electrical heating systems – resistance, induction, microwave and radiant heating; characteristics of industrial electrical heating techniques; Lighting control systems for improving energy efficiency of lighting; Efficiency analysis of D.C. motors and Induction motors; control arrangements for D.C. motors and Induction motors.

Analyzing energy efficiency for industrial SMEs.

Text Books:

1. Hodge B.K., Analysis and Design of Energy Systems, Prentice Hall.
2. Shields C. D., Boilers – Types, Characteristics and Functions, McGraw Hill.
3. Dryden I.G.C., The Efficient Use of Energy, Butterworth Scientific.
4. Hughes A., Electric Motors and Drives, 3rd edition, Newnes, Elsevier.

Reference Books:

1. Thollander P. and Palm J., Improving Energy Efficiency in Industrial Energy Systems, Springer.
2. Spera D.A., Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering,American Society of Mechanical Engineers.

Subject Name: Solar Photovoltaic System Design					
Paper Code: REEN 5244					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:

1. To demonstrate knowledge of different solar cells modules and uses.
2. To describe working of the solar cell modules.
3. To explain the selection of batteries for different solar systems.
4. To apply engineering materials in renewable Energy/ power generation.
5. To design grid connected and standalone solar systems.

Module 1: [10 L]

Brief Introduction to Renewable Energy Technologies, Solar radiation and its characteristics, Radiationestimation and Energy output prediction.

Manufacturing of solar cells: Basics of functioning of solar cell, first generation, second generationand third generation solar cells, Nano-structured Solar PV cell, Concentrating PV system.

Module 2: [10 L]

Measurement and analysis of cell: Solar cell efficiency, I-V characteristic, measurement and analysis of solar cell, Cell temperature effect, IPCE measurement, Reliability standards and reliability testing methods, Reliability Modelling. Solar PV module and array, Shading impact: Bypass diode, blocking diode.

Module 3: [10 L]

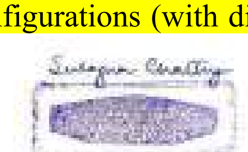
Solar PV system equipments: Battery, Inverter, Sun tracker, Charge controllers, Battery parameters and their losses, Factors effecting battery performance: voltage level, discharge current, temperature during discharge, Choice of a battery, Charging and discharging methods, Batteries for PV systems: Lead acid batteries, Nickel cadmium (Ni- Cd) Batteries.

Converters: DC-DC convertors: Introduction and their classification, Control of DC to DC converters, DC to AC converters (Inverters): Single phase DC to AC converter, Three phase DC to AC converter.

Module 4: [10 L]

Maximum power point tracking (MPPT), Charge Controllers: Commonly used Set Points, Type of charge controllers (Shunt type, Series type and MPPT).

Design methodology of PV systems: Design of PV powered DC fan without battery, Design of PV powered DC pump, Standalone PV system configurations (with different types of loads



e.g. DC, with battery and DC, AC/DC, battery and AC/DC), Grid connected system without energy storage, Load characteristics, Effect of tracking.

Applications of PV System: Direct coupled, Grid connected, Stand alone, Hybrid system, PV System Economics.

Reference Books:

1. Solanki C.S., Solar Photovoltaics – Fundamentals, Technologies and Applications, 2nd ed., PHILearning, 2011.
2. Roy J.N. & Bose D.N., Photovoltaic Science and Technology, Cambridge University Press 2018.
3. Master G.M., Renewable and Efficient Electric Power System,; IEEE Press.
4. Andrews J. & Jelly D.N., Energy Science: Principles, Technologies and Impacts, OxfordUniversity press.

Roy J.N. & Bose D.N., Introduction to VLSI Design and technology, New Age Publication

Subject Name: Solar energy laboratory					
Paper Code: REEN5252					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**2**

Course outcomes:

1. Student will be able to design processes producing alternative source of energy.
2. Students will be able to characterize the quality of fuel generated from alternative source.
3. Students will be able to operate electrical equipments for power generation.
4. Students will be able to understand chromatographic technique used for gas mixture analysis.

Experiments:

At least any five experiments are to be carried out by students

1. Measurement of solar radiation at different location.
2. Estimating the effect of sun tracking on energy generation by solar PV modules.
3. Efficiency measurement of Stand-alone Solar PV System.
4. Determine the effect of colors (wavelengths) on the efficiency of solar cell.
5. V-I Characteristics of the solar cell at different irradiance level using solar simulator.
6. Measurement of current-voltage characteristics of two solar cells connected a) in series and b) in parallel.
7. Extraction of Solar PV Module parameters from the V-I curve: (i) Short Circuit Current (I_{sc}) (ii) Open Circuit Voltage (V_{oc}) (iii) Fill Factor (iv) Efficiency.

Subject Name: Business Analytics					
Course Code : CSEN6121					
Contact hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	

Course Outcomes:

1. Students will demonstrate knowledge of data analytics.
2. Understand and critically apply the concepts and methods of business analytics
3. Students will demonstrate the ability to use various techniques to support data driven business decision-making.
4. Student will demonstrate how to recognize trends, detect outliers, summarize data sets and analyze relationships between variables
5. Able to develop and test hypotheses
6. Initiate interest to learn various tools used in this area on his/her own.

Module I [8 L]

Introduction: Overview of Business analytics, Business analytics vs Business Analysis vs Data Science, Scope of Business analytics, Business Analytics Process, Organization structure needed for effective Analytics, Competitive advantages of Business Analytics, Data and models for Business analytics

Data Visualization : Summarizing Data (Mean, Mode, Variance, Standard Deviation, Skewness), Tools for Single variable (histogram), Tools for Pairs of variables (box plot, scatter plot, contour plot), Tools for Multiple variables.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

Module II [10 L]

Types of Statistical Analysis: Descriptive type of statistical Analysis, Inferential Type of Statistical Analysis, Predictive Analytics, Perspective Analytics and its step in the business analytics Process, Causal Analysis, nonlinear Optimization.

Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression.

Data Mining techniques: Classification, clustering, Association rules, Outer detection, Sequential Patterns used in business analytics.

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Module III [10 L]

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, News vendor Model, Overbooking Model, Cash Budget Model.

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Module IV [8 L]

Recent Trends in Business Analytics: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Business Analytics Tool – R: Overview of R, Some basic coding syntax of R, Discuss some Modeling Techniques in Business Analytics with R for simple problems.

Reference:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Subject Name: Advanced Artificial Intelligence					
Paper Code: CSEN6122					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After the completion of the course, the students will be able to:

1. Understand the building blocks of artificial intelligence, knowledge representation, reasoning, and machine learning techniques to real-world problems.
2. Formulate and solve problems with uncertain information using Bayesian approaches.
3. Learn supervised and unsupervised learning techniques and criteria of their performance assessment.
4. Employ fuzzy logic for development of artificial intelligent systems.
5. Familiar with AI search algorithms like genetic algorithms.
6. Develop artificial neural network model for different classification problems as well as understand basic of some of the more advanced topics of AI such as deep learning and convolutional neural network.

Module I – [9L]

Introduction to AI: Logic foundations of Artificial Intelligence, Constraint reasoning, Qualitative reasoning, Probabilistic reasoning- Bayesian probability, Steps of Bayesian problem solving, Naïve Bayesian Learning Model, Boosting of naïve Bayesian model-AdaBoost Algorithm.

Module II - [9L]

Learning: Supervised, Unsupervised and Reinforcement learning; Learning decision trees; Generalization and over fitting, Cross validation, Loss function, Regularization, Complexity versus goodness of fit.

Regression and classification with linear Models- Univariate linear regression, Multivariate linear regression, Linear classification with logistic regression; Perceptron Learning Algorithm (linear model), Adaline and Madaline; K-nearest neighbor model.

Module III - [9L]

Emergent Intelligence: Fuzzy expert systems- Fundamentals of Fuzzy sets, membership functions, Linguistic variables and hedges, operations on fuzzy sets, fuzzy rules, fuzzy inference, examples of building fuzzy expert system, fundamental issues with Fuzzy systems;

Evolutionary computation- Formal model of evolution system theory, Darwin's evolutionary algorithm, Classifier system; Genetic algorithm - basic principles of genetic algorithm, genetic operators, simple illustration of genetic algorithm with examples.

Module IV - [9L]

Neural Networks & Deep Learning: Introduction- Basic models of artificial neurons, activation functions, Simple perceptron, multilayer perceptron, Backpropagation learning algorithm, Applications of neural networks in classification and estimation.

Deep learning – Concepts of deep learning, deep networks, training of deep networks, applications of deep learning; Convolutional neural network, recurrent neural network

References:

1. Stuart J. Russell and Peter Norvig, *Artificial Intelligence A Modern Approach*, 3rd Edition, Pearson, 2016.
2. Toshinory Munakata, *Fundamentals of the New Artificial Intelligence- Neural, Evolutionary, Fuzzy and More*, Second Edition, Springer, 2008.
3. Richard E. Neapolitan, Xia Jiang, *Artificial Intelligence- With an Introduction to Machine Learning*, Second Edition, CRC Press, 2018.
4. Michael Negnevitsky, *Artificial Intelligence- A Guide to Intelligent Systems*, Addison-Wesley.
5. Neural Networks and Learning Machines, Simon Haykin, Third Edition, PHI Learning, 2009.
6. Y. S. Abu-Mostafa, M. Magdon-Ismail, H. T. Lin, Learning from Data A short Course, AMLbook.com.
7. J. Han and M. Kamber, Data Mining Concepts and Techniques, 3rd, Edition, Morgan Kaufmann Publishers, July 2011.

Paper Name: **OPTIMIZATION TECHNIQUES (M. Tech. Open Elective)**					
Paper Code: **MATH 6121**					
Contact hours per week:	L	T	P	Total	Credit Points
	4	0	0	4	4

<u>After successfully completing this course the students will be able to:</u>

MATH6121.1 Describe the way of writing mathematical model for real-world optimization problems.
MATH6121.2 Identify Linear Programming Problems and their solution techniques.
MATH6121.3 Categorize Transportation and Assignment problems.
MATH6121.4 Apply the way in which Game Theoretic Models can be useful to a variety of real-world scenarios in economics and in other areas.
MATH6121.5 Convert practical situations into non-linear programming problems.
MATH6121.6 Solve unconstrained and constrained programming problems using analytical techniques.

<u>Detailed Syllabus:</u>

<u>Module I:</u> [10L]

Linear Programming Problem (LPP)-I: Formulation of an LPP; Graphical Method of solution of an LPP; Convex Combination and Convex Set; Convex Hull and Convex Polyhedron; Canonical and Standard form of an LPP; Basic Solution of a system of linear equations; Simplex Method; Big-M Method; Concept of Duality; Mathematical formulation of duals.

<u>Module II:</u> [10L]

Linear Programming Problem (LPP)-II: Transportation Problems (TP); Representation of Transportation Problems as LPP; Methods of finding initial basic feasible solution of TP: North-West Corner Rule, Matrix Minima Method, Vogel's Approximation Method; Optimality test of the basic feasible solution; Assignment Problems; Hungarian Method.

<u>Module III:</u> [10L]

Game Theory: Introduction; Strategies; The Minimax and Maximin Criterion; Existence of Saddle Point; Two person zero sum games; Games with a saddle Point – Pure Strategies; Games without a Saddle Point – Mixed Strategies; Symmetric Games; Dominance Principle; Graphical Method of Solution; Algebraic Method of Solution.

<u>Module IV:</u> [10L]

Non-Linear Programming Problem (NLPP): Single-variable Optimization; Multivariate Optimization with no constraints: Semi-definite Case, Saddle Point; Multivariate Optimization with Equality Constraints: Method of Lagrange Multipliers; Multivariable Optimization with inequality constraints: Kuhn-Tucker Conditions.

Sandip Chatterjee

References:

1. Linear Programming and Game Theory by J. G. Chakraborty and P. R. Ghosh, Moulik Library.
2. Operations Research by Kanti Swarup, P. K. Gupta and Man Mohan, S. Chand and Sons.
3. Engineering Optimization by S. S. Rao, New Age Techno Press.
4. Operations Research by J K Sharma, Macmillan India Ltd.

Subject Name: Energy Management and Audit					
Paper Code: REEN6101					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]

General Philosophy and need of Energy Audit and Management. Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy. Energy Audit: Need, Types, Methodology and Approach.

Energy Management Approach, Understanding Energy Costs, Bench marking, Energy performance, Matching energy usage to requirements, Maximizing system efficiency, Optimizing the input energy requirements, Fuel and Energy substitution.

Module 2: [10L]

Procedures and Techniques:

Data gathering: Level of responsibilities, energy sources, control of energy and uses of energy get Facts, figures and impression about energy /fuel and system operations, Past and Present operating data, Special tests, Questionnaire for data gathering.

Analytical Techniques: Incremental cost concept, mass and energy balancing techniques, inventory of Energy inputs and rejections, Heat transfer calculations, Evaluation of Electric load characteristics, process and energy system simulation.

Evaluation of saving opportunities: Determining the savings in Rs, Noneconomic factors, Conservation opportunities, estimating cost of implementation.

Energy Audit Reporting: The plant energy study report- Importance, contents, effective organization, report writing and presentation.

Module 3: [10L]

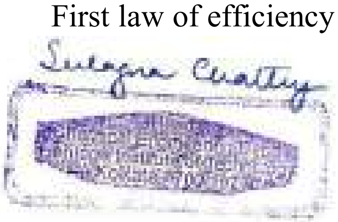
Energy Policy Planning and Implementation:

Key Elements: Force Field Analysis, Energy Policy-Purpose, Perspective, Contentsand Formulation.

Format and Ratification, Organizing: Location of Energy Manager, Top Management Support, Managerial functions, Role and responsibilities of Energy Manager, Accountability. Motivating– Motivation of employees, Requirements for Energy Action Planning. Information Systems: Designing, Barriers, Strategies, Marketing and Communicating Training and Planning.

Module 4: [10L] Energy Balance & MIS:

First law of efficiency and Second law of efficiency, Facility as an Energy system, Methodsfor



preparing process flow, Materials and Energy Balance diagram, Identification of losses,

Improvements. Energy Balance sheet and Management Information System (MIS) Energy Modeling and Optimization.

Energy Audit Instruments: Instruments for Audit and Monitoring Energy and EnergySavings, Types and Accuracy

Text/ Reference Books:

1. Energy Management: W.R.Murphy, G.Mckay (Butterworths).
2. Energy Management Principles: C.B.Smith (Pergamon Press).
3. Efficient Use of Energy : I.G.C.Dryden (Butterworth Scientific)
4. Energy Economics -A.V.Desai (Wieley Eastern)
5. Industrial Energy Conservation : D.A. Reay (Pergammon Press)
6. Industrial Energy Management and Utilization – L.C. Witte, P.S. Schmidt, D.R. Brown (Hemisphere Publication, Washington)

Subject Name: Renewable Energy III					
Paper Code: REEN6102					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]
Water Resources & Hydro Planning: Categorization, development and purposes of water resources, Classification of hydro projects, Small Hydro Power (SHP) development and its relevance, allotment of sites, opportunities; hydropower planning on existing structures and new sites; Different methods for stream gauging, rainfall, runoff and its estimation by different methods, peak flood estimation, demonstration of discharge measuring instruments ; Flow duration studies, assessment of power potential and optimisation of installed capacity; Topographical, geological and power evacuation surveys and investigations, demonstration of surveying instruments, site selection for SHP and other projects;Financing of projects, cost estimation for different components, financial and economic analysis,valuation of Hydro Assets, clean development mechanism, management of Hydro plants.

Module 2: [10L]
Design of SHP and other Hydro Structures: Hydraulics and structural designs of civil works, national and international standards and codes of practice, diversion works and intakestructures, site selection, innovative designs; Power house layouts , channel (lined and unlined), under drainage works, tunnels and tail race channel; Sediment properties and transport, desilting devices, silt disposal; Cross drainage works; Balancing reservoir, spillway and forebay tank;Penstock, anchor block and saddle, surge tank; Power house buildings, material handling, machine foundation,Seismolgical consideration.

Module 3: [10L]
Electro Mechanical Hydro Equipments: Types, characteristics and testing of ac generators; Sizing and specification of single and three phase generators ; Power factor and its correction methodologies, excitation systems; Electro-mechanical and digital governor, electronic load controller ; Types of relays, contactors and control schemes for hydro stations; Supervisory control and data acquisition (SCADA), integrated computer control system ; Switchyard equipments, power and instrument transformers, circuit breakers, bus- bar; Protection schemes for generator, transformer and bus-bar, design of circuit diagram for auxiliary and grounding systems.

Module 4: [10L]
Classification and working principles of hydro turbines, different components of impulse and

reaction turbines; Design concepts of hydro turbines, pump-as-turbine and other non conventional hydro turbines; Characteristics of hydro turbines, geometric similarity, main characteristic and operating characteristic curves, hill curves; Governing of hydro turbines,

Text/ Reference Book/ Literature:

1. Nigam, P.S., "Handbook of Hydroelectric Engineering", Nem Chand and Brothers.
2. Clemen, D.M., "Hydro Plant Electrical Systems", HCI Publication.
3. Kundur, P., "Power System Stability and Control", McGraw Hill Inc.
4. Fritz, J.J., "Small and Mini Hydro Power Systems: Resource Assessment and Project Feasibility", McGraw Hills.
5. Gulliver, J.S. and Arndt, E.A., "Handbook of Hydro Electric Engineering",McGrawHills.
6. Varshney, R.S., "Hydropower Structures", Nem Chand and Brothers.

Subject Name: Renewable Energy Laboratory					
Paper Code: REEN6111					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**6**	**6**	**2**

Experiments:

At least any five experiments are to be carried out by students

1. Study on thermal performance and efficiency of biomass downdraft gasifier;
2. Sampling and analysis of air and flue gas from biomass energy systems (i.e. gasifier, combustor and cook stoves) using gas chromatography technique;
3. Biogas production by anaerobic digestion and analysis;
4. Fuel Cell operation and electrical power generation;
5. Wind Tunnel: Pressure distribution analysis;
6. Performance analysis of an Electrical Inverter
7. Measurement of power factor and load characteristics of Power generator
8. Air conditioning performance test
9. Refrigeration performance test & COP measurement
10. Step-up and step-down Transformer Characteristics

Subject Name: Energy Transmission Technology					
Paper Code: REEN6141					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]
Introduction to DC-DC converter, Control strategies, Types of DC choppers andits classification, Brief idea about Buck, Boost and Buck-Boost chopper.
Introduction to inverters, Classification of inverters, Principle of operation of single phase and three phase bridge inverter with R and R-L loads.

Module 2: [10L]
Introduction of Smart Grid. Application of smart Grid. Capabilities of Smart Grid, Phasor measurement Unit. Communication technologies for the Smart Grid. Wide area monitoring System. Automatic Meter reading System. Basic concept of demand side planning. Concept of Micro-Grid.

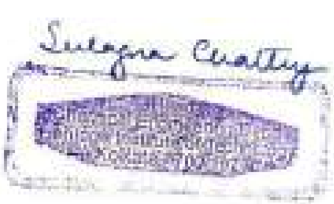
Module 3: [10L]
Overhead Transmission Line: Choice of frequency & voltage, Types of Conductors, Line Resistance, Inductance and Capacitance of single phase and three phase overhead lines. Influence of earth on conductor capacitance. Basic concept of Transmission Tower, Insulators, Spacer, Damper.

Module 4: [10L]
Transmission System: Short, Medium (nominal T and π) and Long transmission lines (equivalent T and π) and their representation. ABCD constants. Concept of HVAC- HVDC transmission system.
Distribution Systems: Introduction of Distributing System. Radial and Ring main systems.

D.C. Three-wire system. Different types of distributors. Method of calculations. A.C. Distributors with Concentrated loads.

Text/ Reference Book:

1. Elements of power system analysis, C.L. Wadhwa, New Age International
2. Electrical Power System, Ashfaq Hussain, CBS Publishers & Distributors
3. Power Electronics, P.S Bimbhra, Khanna Publishers
4. Smart Grid Technology and Applications, Janaka Ekanayake, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins, Wiley Publications.
5. A Text book on Power system Engineering, Soni, Gupta, Bhatnagar &Chakrabarti, Dhanpat Rai & Co.
6. Power Electronics: Circuits, Devices and Applications (English) 3rd Edition, M.H Rashid,



Pearson, India.

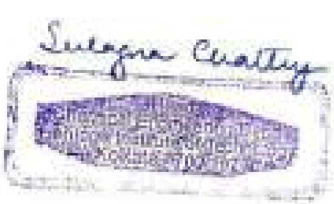
Subject Name: Energy Trading and Pricing					
Paper Code: REEN6142					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module 1: [10L]
Overview of Energy Markets & Pricing: Integrated framework for Energy Pricing, Basic Pricing Principles, Short run and Long run Marginal Cost Pricing, Peak load &seasonalPricing, Energy Prices and Markets, Prices of Exhaustible Energy Resources, Economic Regulation of Energy Markets, Drivers of Energy Demand, Concept of Energy Intensity & Energy Elasticity, Statistical tools & techniques for scenario forecasting, Interpretation of results & Policy implications.

Module 2: [10L]
Energy Trading: Renewable Energy Guidelines of Central Regulatory Energy Commission& State Policies, Power Purchase Agreement framework, Modelling for determining Feed in Tariff for Power Producers and Utilities, Peak Power Trading ,Regional Load Despatch Centres, Renewable Energy Credit mechanism, Cost benefit of selecting Feed in tariff as against REC route for Power Producers, Outlook for REC Demand & Pricing, Interventions by the Government for stimulating REC Offtakes & Price, Indian Energy Exchange ,International Platforms for Energy Trading, Energy Futures, Crude and Natural Gas Pricing& Futures, Risk Management in Energy Trading.

Module 3: [10L]
Investment in Energy Resources: Levelized cost of Energy Resources, Financial and Economic analysis of Energy Technologies, Private and Social Costs, Cash Flow Projections and Discounting, Enterprise Valuation of Renewable Energy Assets, Funding options, Case Studies on Acquisition and Disinvestment of Renewable Energy Assets, Risk Return analysis for Renewable Energy Assets, RE Portfolio for Risk mitigation & Hedging.

Module 4: [10L]
Energy Modelling, Planning and Policy Evolution: Concepts in Modelling Energy Resources, Review of various Energy Sector Models, Energy Modelling in the context of Climate Change, Key developments and Evolution of Energy Policies in India, Environmental concerns and Regulatory framework, Reforms outlook.



Text/ Reference Book/ Literature:

1. Cooper, John C.B.(2003):“Price elasticity of demand for crude oil: estimates for23 countries,” OPEC Review, 27:1-8.
2. Bohi, D.P. (1981): Analyzing Demand Behavior: A Study of Energy Elasticities,Johns Hopkins University Press.
3. Haider, Ghazi M. (2000):“World oil reserves: Problems in definition andestimation,” OPEC Review, 24: 305-327.
4. Adelman, M.A. (2002):“World Oil Production and Prices 1947-2000,”TheQuarterly Review of Economics and Finance, 42: 169-191.
5. Barretto,L.,A.Makihiraand,K.Riahi(2003):“The hydrogen economy in the 21st century: a sustainable development scenario,” International Journal of Hydrogen Energy, 28: 267-284.
6. Bentley, R.W. (2002):“Global oil & gas depletion: an overview,” Energy Policy, 30:189-205.

Paper Name: INTRODUCTION TO PROGRAMMING					
Paper Code: MCAP1101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

<u>Course Outcomes:</u>

1. Understand the flow of control in order to solve a real time problem.
2. Understand and remember how a high-level language (C programming language, in this course) works, different stages a program goes through.
3. Understand and remember syntax and semantics of a high-level language (C programming language, in this course).
4. Understand the programming constructs in order to solve a problem of given nature.
5. Apply high-level language to automate the solution to a problem.
6. Apply high-level language to implement different solutions for the same problem and analyze why one solution is better than the other.

Module I [10L]

Introduction: History of Computing, Evolution of Programming Languages, Compilers, Familiarization with UNIX.

Problem Solving Method: Algorithm, Flowchart, Problem-Solving Methodology- Tools, Pseudo code.

Overview of C language: C Standards, Structure of a C Program, C Libraries, Steps of Compilation of a C Program.

Expressions: Basic Data Types, Variables, Type Qualifiers, Storage Class Specifiers, Variable Scopes, Constants, Operators, Operator Precedence, Expression Evaluation, Type Conversion in Expressions, Type Casting.

Console I/O: Reading and Writing Characters, Reading and Writing Strings, Formatted Console I/O.

Module II [10L]

Control Statements: Selection Statements (if, switch-case), Iteration Statements (for loop, while loop, do-while loop), Jumping Statements (return, goto, break, exit, continue).

Function: Functions and Modular Programming, General Form, Function Prototypes, Library Functions, Parameter Passing Mechanisms, Storage Classes, Recursive function.

Souvik Basu

Module III [10L]

Arrays and Strings: Single Dimension Arrays, Two Dimension Arrays, Multidimensional Arrays, Strings, Arrays of Strings, String Library Functions.

Pointer: Pointers and Memory Addressing. Pointer Variables, Pointer Arithmetic, Pointer Expressions, Pointers and Arrays, Functions and Pointers, Dynamic Memory Allocation, Command Line Arguments.

Module IV [10L]

Structures, Unions, Enumerations: Structures, Arrays of Structures, Structure and Pointers, Unions, Bit Fields, Enumerations, typedef keyword**.**
File I/O: Concept of Files, File operations, Text Files and Binary Files.

The Preprocessor: Preprocessor Directives, Macros, File Inclusion.

Text Books:

1. Programming with C - Gottfried, TMH.
2. Programming in C - Balagurusamy, Tata McGraw-Hill.
3. Programming in C – ReemaThareja, Oxford University Press.

Reference Books:

1. C Programming Made Easy - Raja Ram, SCITECH.
2. The C Programming Language - Kernighan Ritchie, PHI.

Souvik Basu

Paper Name: MATHEMATICAL FOUNDATIONS					
Paper Code: MCAP1102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

1. Understand the basics of Mathematical Logic and how that can be abstracted through logical variables and connectives.
2. Develop the concept of Graphs and their properties with respective algorithms to explore some of the fundamental ideas of Computer Science.
3. Combine the ideas of Permutation & Combination to solve some real world computational problems.
4. Analyze the nature of generating functions and recurrence relations.
5. Understand the Boolean Algebra and its inner working for lower level computation.
6. Develop the basic idea of Automata theory and its significance for the modern theory of Computational Linguistics.

Module I [10L]

Mathematical Logic: Propositions, Connectives, Conditionals and Bi conditionals, Well-formed formulas (WFF), Tautologies, Equivalence formulas, Law of duality, Normal Forms, Predicate Calculus, Free and Bound variables.

Abstract Algebra: Set, Relations and Well-ordering principle, Functions. Algebraic structures, Semi-group, Group, Subgroup, Order of a group, Cyclic-group, Homomorphism. Application of residue arithmetic in computer.

Module II [10L]

Graph Theory: Basic Concepts of Graphs-definitions, Walk, Trail, Path, Isomorphic graph, connected graph, Euler graph. Trees, Forest, Adjacency and Incidence Matrices, Minimum Spanning Tree (Prim's and Kruskal's Algorithm), Shortest Path (Dijkstra's Algorithm),Planar Graph. Storage representation and manipulation of graphs, List-structures. Various applications of Graph Theory in Computer Science.

Module III [10L]

Permutation and Combination: Concepts of Permutations and Combinations, Inclusion-Exclusion Principle, Pigeon-hole principle, Euclidean algorithm for Linear Diophantine Equation, Basic Counting Concepts. Formula derangement, Restrictions on relative positions.

Souvik Basu

Generating- function and Recurrence relation: Generating-function, Recurrence-relations, Linear recurrence-relations with constant coefficients, Solution by Generating-function.

Module IV [10L]

Boolean Algebra: Definition of Boolean algebra, Boolean function Simplification. SOP and POS forms.

Mathematical Computing: Finite Automata – definition and construction, DFA, NFA, NFA to DFA conversion, State-minimization, Mealy M/C, Moore M/C, problem and solution.

Definition of Grammars: Unrestricted grammar, Context-sensitive grammar, Context-free grammar, Regular grammar.

Text Books:

1. Discrete Mathematics and Its Applications - KH Rosen,TMH.
2. Elements of Discrete Mathematics -C.L Liu, McGraw Hill.
3. Discrete Mathematical Structure - Kolman, Busby and Ross, PHI.

Reference Books:

1. Discrete Mathematics Theory, Problems and Solutions – Dipendra Nath Ghosh, Academic Publishers.
2. Graph Theory with Application to Engineering and Computer Science - N. Deo, PHI.
3. Theory of Computer Science –K.L.P. Mishra and N. Chandrashekharan, PHI.

Souvik Basu

Paper Name: NUMERICAL ANALYSIS					
Paper Code: MCAP1103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

1. Develop the ideas of numerical computations and the various types of errors occur in numerical computations.
2. Apply various Algebraic and Transcendental Equations to solve specific problems of numerical computation with their rate of convergence.
3. Develop numerical techniques to obtain approximate solutions to mathematical problems where analytical solutions are not possible to evaluate.
4. Analyze certain real life problems that can be transformed in terms of numerical differentiation and integration.
5. Apply techniques to solve the system of linear equations.
6. Apply various techniques to solve ordinary differential equations.
7. Analyze the basics of approximation theory through least square method.
8. Develop the ideas of various linear and nonlinear curve fitting techniques.

Module I [8L]

Errors in Numerical Computations: Computing Arithmetic, Sources of Errors, Significant Figures: Absolute, Relative and Percentage Errors. Significant Digits, Generation and Propagation of Round-off Error.

Solutions to Algebraic and Transcendental Equations: Introduction, Bisection Method, Secant Method, RegulaFalsi Method , Newton Raphson Method , Iterative or Successive Approximation Method , Comparison of Iterative Methods, Convergence of different methods, Algorithm and Flowchart of different methods.

Module II [10L]

Interpolation and Polynomial Approximation: Introduction, Lagrange's Interpolation , Finite Difference Operators, Error in Interpolating polynomial, Interpolation Techniques Based on Finite Differences , Forward and Backward Differences, Newton's Forward Difference Interpolation Method, Newton's Backward Difference Interpolation Method, Inverse Interpolation .

Module III [12L]

Numerical Differentiation and Integration: Introduction, Differentiation based on Newton's Forward and Backward Interpolation Formula, Different Operators, Trapezoidal Rule, Simpson's 1/3rd Rule, Simpson's 3/8th Rule, Errors in Integration Formulae, Algorithm and Flowchart of different methods.

Solutions to System of Linear Equations: Introduction, Gauss Elimination Method, Gauss Jordan Elimination Method, Triangularization or LU Decomposition Method, Jacobis Iteration Method, Gauss Seidel Iterative Method, Comparison and choice of Methods, Eigen-Value problem, Algorithm of different methods.

Souvik Basu

Module IV [10L]

Solutions to Ordinary Differential Equation: Introduction, Taylor Series Method, Euler's Method, Modified Euler's Method, RungeKutta Method, Algorithm of different methods.

Approximation Theory: Least Square Approximation.

Curve Fitting: Curve fitting using Least Square Method – Linear, Quadratic, Cubic, and Exponential.

Textbooks:

1. Introductory Numerical Analysis – Dutta and Jana, Shreedhar Prakashani.
2. Introductory Methods of Numerical Analysis - S. S. Sastry,PHI

Reference Books:

1. Computer Oriented Numerical Methods - V. Rajaraman,PHI
2. Numerical Analysis and Computational Procedures - S. Ali Mollah, Books & AlliedLtd.
3. Numerical Mathematical Analysis - James B. Scarborough, Oxford.

Souvik Basu

Paper Name: PROGRAMMING LAB					
Paper Code: MCAP1111					
Contact hrs per week:	L	T	P	Total	Credit Points
	0	0	4	4	3

Software to be used: GNU C Compiler (GCC) with LINUX
NB: Cygwin (Windows based) may be used in place of LINUX

Course outcomes:
1. To write simple programs relating to arithmetic and logical problems.
2. To be able to interpret, understand and debug syntax errors reported by the compiler.
3. To implement conditional branching, iteration (loops) and recursion.
4. To decompose a problem into modules (functions) and amalgamating the modules to generate a complete program.
5. To use arrays, pointers and structures effectively in writing programs.
6. To be able to create, read from and write into simple textiles.

Problems related to the following topics:

Topic 1: LINUX commands and LINUX based editors,
Topic 2: Basic Problem Solving,
Topic 3: ControlStructures,
Topic 4: Array (1-d, 2-d),
Topic 5: Functions,
Topic 6: Dynamic MemoryAllocation,
Topic 7: String Handling,
Topic 8: Structure andUnion,
Topic 9: File Handling.

Souvik Basu

Paper Name: COMPUTER ORGANIZATION AND ARCHITECTURE					
Paper Code: MCAP1201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

1. Understand Binary Number system, and logic design using basic logic gates and universal gates.
2. Able to design applications of Sequential Circuits.
3. Able to design Finite State Machines.
4. Understand the basic organization of computer and different instruction formats and addressing modes.
5. Analyze the concept of pipelining, vector-processing, segment registers and pin diagram of CPU.
6. Understand and analyze various issues related to memory hierarchy and memory mapping technologies.
7. Understand various modes of data transfer between CPU and I/O devices.

Module I [10L]

Boolean Algebra & Logic Gates: Logic gates- truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, Kmap method.

Combinational Circuits: Combinational circuits- Adder and Subtractor circuits; Applications and circuits of Encoder, Decoder, Multiplexer, De-Multiplexer and Parity Generator.

Module II [10L]

Sequential Circuits: Sequential Circuits - Basic memory element - S-R, J-K, D and T flip flops; Registers and counters and their design, Irregular counter, State table and state transition diagram; Sequential circuits design methodology.

Instruction Formats: Introduction to basic structures and operational concepts, Instruction formats, Instruction execution, sequencing, addressing modes.

Module III [10L]

Control Unit: Concepts, Fetching and storing word from/in main memory, Register transfers, Operations, execution of a complete instruction, Hardwired control, Micro programmed control.

Memory: Basic concepts, RAM, ROM – different types, Characteristics, Memory design (Linear addressing, interleaved memory) Cache memories, Performance (memory interleaving, hit rate etc.), Memory hierarchy - virtual memory – address translation, Secondary memories Data transfer through programmed I/O, interrupt and DMA, I/O processors.

Souvik Basu

Module IV[10L]

Input/output organization: Memory mapped, standard (isolated) and linear selection techniques of I/O addressing.

Pipelining: Arithmetic & instruction, speedup, vector processing, array processor, Introduction to RISC processor and parallel processing, Bit-Slice processors.

Text Books:

1. Digital Logic and Computer Design - M. Morris Mano, Pearson.
2. Computer System Architecture - Morris Mano, PHI.
3. Digital Logic Design – Mansaf Alam, Bashir Alam, PHI.

Reference Books:

1. Computer Organization – C. Hamacher, Z. Vranesik, S. Zaky, McGraw-Hill.
2. Computer Architecture and Organization – John P. Hayes, McGraw-Hill.
3. Digital Design: Basic Concepts and Principles - Mohammad A. Karim, CRC Press.

Souvik Basu

Paper Name: DATA STRUCTURES					
Paper Code: MCAP1202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course outcomes:

1. Understand and remember the basics of data structures and Abstract data type(ADT).
2. Understand the significance and utility of different data structures and the context of their application.
3. Apply different types of data structures in algorithms and understand how the data structures can be useful in those algorithms.
4. Evaluate solutions of a problem with different data structures and thereby understand how to select suitable data structures for a solution. (For example, what are the different ways to find the second largest number from a list of integers and which solution is the best.)
5. Evaluate different types of solutions (e.g. sorting) to the same problem.

Module I[8L]

Introduction: Concepts: Data type and data structure, Abstract Data Type. Classification, Algorithms concepts. Analysis: space and time analysis of algorithms – Big O, Θ, Ω notations.

Array: Different representations – row major, column major. Sparse matrix – its implementation and applications. Array representation of polynomials.

Linked List: Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Module II[8L]

Stack and Queue: Stack - implementation using array and linked list. Applications. Queue, circular queue, deque - implementation using array and linked list, applications.

Recursion: Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi.

Module III[12L]

Graphs: Graph representations / storage – using adjacency matrix, adjacency list.

Trees: Basic Terminologies, tree representation – using array and linked list. Binary trees: traversal (pre-, in-, post-, level- order). Threaded binary trees. Huffman trees. Heaps – implementation of priority queue. Binary Search trees, AVL tree (insertion, deletion with examples only), B-tree (insertion, deletion with examples only), Tree (insertion, deletion with examples only).

Souvik Basu

Module IV[12L]

Searching: Sequential, Binary. Complexity analysis and comparison.

Sorting: Introduction – idea about internal and external sorting, in-place sorting, stability, adaptivity. Sorting algorithms - Bubble, Insertion, Selection, Shell, Quick, Merge, Heap, Radix. Complexity analysis (Average case analysis not required), and comparison.

Hashing: Hash Functions. Collision resolution – open and closed hashing.

Text Books:

1. Classic Data Structures – Debasis Samanta, PHI Learning.
2. Data Structures and Program Design in C - Robert L Kruse, Bruce P. Leung, Pearson Education.
3. Data Structures using C - Aaron M Tenenbaum, Moshe J Augustein, Pearson Education.

Reference Books:

1. Data Structures -Seymour Lipshutz, McGraw-Hill.
2. Fundamentals of Data Structures in C -Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Universities Press.

Souvik Basu

Paper Name: DATABASE MANAGEMENT SYSTEMS I					
Paper Code: MCAP1203					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

1. Understand and describe data models and schemas in DBMS.
2. Understand the features of database management systems and Relational database.
3. Apply relational algebra and calculus to interpret data in relational format.
4. Apply SQL the standard language of relational databases.
5. Analyze the functional dependencies and design of the database.
6. Understand the concept of storage for various forms of data.
7. Develop the concept of different levels of indexing to optimize query processing.

Module I[10L]

Introduction to DBMS: Basic Concepts of Operational Data, Data vs. Information, Introduction to Database and DBMS, Importance of Database Design, Files and File Systems, Problems with File System Data Management, Database Systems, Views of Data, Three-Level Architecture, Instances and Schemas, Database Administrator, Database Users, Advantages and Disadvantages of DBMS.

Data Model: Data Modeling and Data Models, Importance of Data Models, Data Model Basic Building Blocks, The Evolution of Data Models, Degree of Data Abstraction.

Entity-Relationship Modeling: Entity and Entity Instances, Attributes, Entity Relationships, Cardinality of Relationships, Strong and Weak Entity, Generalization, Specialization, Aggregation, Developing an ER Diagram, Entity Integrity and Primary Key, Translating ER Model into Relational Model.

Module II [10L]

Relational Model: A Logical View of Data, Keys, Integrity Rules, Relational Set Operators, Data Dictionary and the System Catalog, Relationships within the Relational Database, Data Redundancy Revisited, Indexes, Codd’s Relational Database Rules.

Relational Database Design: Functional Dependency (FD) –Definition, Trivial and Non-Trivial FD, Closure of Set of FD, Closure Of Attribute Sets, Irreducible Set of FD, Canonical Cover, Normalization – 1NF, 2NF, 3NF,BCNF, Decomposition using FD, Lossless Decomposition, Dependency Preservation.

Module III[10L]

Relational Algebra: Select Operation, Project Operation, Join Operation, Division Operation, Cross Product Operation, Set operations.

Relational Calculus: Introduction, Tuple Relational Calculus, Operators used in TRC, Example queries using TRC, Domain Relational Calculus, Operators used in DRC, Example queries using DRC, Comparison of TRC, DRC, RA.

Souvik Basu

Structured Query Language (SQL): Introduction to SQL, DDL, DML, DCL, Basic Structure, Basic Queries, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, Assertions, Views, Joining Database Tables, Commit and Rollback.

Module IV[10L]

Advanced SQL: Sub queries and Correlated Queries, SQL Built in Functions - Numeric, Date, String Functions, Updatable Views.

Storage structure: Sequential and indexed file organization, B+ tree - creation, insertion & deletion.

Indexing: Primary, Secondary & Multi Level.

Text Books:

1. Database System Concepts - Korth, Silberschatz, S. Sudarshan, TMH.
2. Fundamentals of Database Systems - Elmsari and Navathe, Addison-Wesley.

Reference Books:

1. An Introduction to Database Systems - Date C. J, Addison-Wesley.
2. SQL-PL/SQL - Ivan Bayross, BPB.

Souvik Basu

Paper Name: INFORMATION SYSTEM ANALYSIS DESIGN AND IMPLEMENTATION					
Paper Code: MCAP1204					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

1. Understand the idea of information system in lieu of the modern abstraction of data.
2. Analyze various phases of system development lifecycle.
3. Gather data to analyze and specify the requirements of system.
4. Design system components and environments.
5. Analyze the feasibility of project.
6. Deliver various types of system documentation.

Module I [10L]

Data and Information: Types of information: operational, tactical, strategic and statutory. Why do we need information systems? Requirement of information at different levels of management, Requirement of information for various functions. Quality of information.

Systems Analysis and Design Life Cycle: System definition and concepts, system environments and boundaries. Real time and distributed systems, basic principles of successful systems. Role and attributes of a systems analyst. Requirements determination, requirements specifications, feasibility analysis, final specifications, hardware and software study, system design, system implementation, system evaluation, system modification.

Module II [10L]

Information gathering: Strategies and methods. System requirements specification.

Feasibility analysis: Deciding project goals, examining alternative solutions, cost–benefit analysis, quantifications of costs and benefits, payback period, system proposal preparation for managements, parts and documentation of a proposal, tools for prototype creation.

Data flow diagrams: Rules and conventions, levels of DFDs, logical and physical DFDs. Software tools to create DFDs.

Module III [10L]
Structured systems analysis and design: Procedure specifications in structured english, decision tables for complex logical specifications, Specification oriented design vs. Procedure oriented design.

Data oriented systems design: Entity relationship model, E-R diagrams, relationships, cardinality and participation, normalizing relations and their use.

Coding practices: Coding techniques, requirements of coding schemes, error detection of codes.
Data input methods: Input Design, validating input data, input data controls, interactive data input.
Designing outputs: Designing output reports- screen design, graphical user interfaces, interactive I/O on terminals.

Souvik Basu

Form design: Classification of forms, requirements of form design, Types of forms, Layout considerations, Form control.

Module IV [10L]

System control: Need for controls, objectives of controls, techniques used in controls, Gantt chart, PERT.

System implementation and maintenance: Planning considerations. Conversion methods, procedures and controls. System acceptance criteria. System Evaluation and Performance. Testing and Validation. Preparing User Manual. Maintenance Activities and Issues.

System audit and security: Audit of Computer System Usage. Types of Threats to Computer System and Control Measures, Threat and Risk Analysis, Disaster Recovery and Contingency Planning, Viruses.

Text Books:

1. Software Engineering: A Practitioner's Approach - Roger. S. Pressman, 7th Edition, Tata McGraw Hill.
2. Systems Analysis and Design - Kendall, Kenneth E and Julie E. Kendall, 7th Edition, Prentice Hall of India.
3. Systems Analysis & Design - Alan Dennis, Barbara H. Wixom and Roberta M Roth, 4th Edition, Wiley &Sons.

Reference Books:

1. System and Design Methods - Jeffrey, L. Whitten and Lonnie D. Bentley, 6th Edition, Tata McGraw Hill
2. Modern Systems Analysis and Design - Jeffrey A. Hoofer, Joey F. George and JosephS. Valacich, 5th Edition, Pearson Education.
3. Systems Analysis and Design Techniques, Methodologies, Approaches, and Architectures - Roger H.L.Chinan, Keng Siau, and Bill C. Hardgrave, 1st Edition, Prentice Hall of India.

Souvik Basu

Paper Name: PROBABILITY AND STATISTICAL COMPUTING					
Paper Code: MCAP1205					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Outcomes:

1. Demonstrate the knowledge of probabilistic approaches to solve wide range of problems.
2. Recognize probability distribution for discrete and continuous variables to quantify physical phenomenon.
3. Appreciate the importance of probability and statistics in computing and research.
4. Understand basic statistical inference techniques for drawing inferences on real life data.
5. Use appropriate statistical methods in the analysis of simple datasets.
6. Interpret and clearly present output from statistical analyses in a clear concise and understandable manner.

Module I[10L]

Probability: Random Experiment, Sample Space, Random Events, Probability of Events, Probability of Non-Disjoint Events (Theorems), Counting Techniques Applied to Probability Problems. Conditional Probability, Stochastic Independence of Events, Bayes' Theorem and Related Problems.

Module II[10L]

Random Variable and Probability Distribution: Concept of Random Variables, Probability Mass Function, Probability Density Function and Distribution Function. Expectation and Variance, Moment Generating Function, Chebyshev's Inequality (statement) and Related Problems. Binomial, Poisson, and Normal Distributions.

Module III[10L]

Sampling and Estimation: Sampling: Population, Sample, Random Sampling, Statistic and its Distribution, Standard Error of Statistic, Sampling Distribution of Sample Mean and Variance in Random Sampling from a Normal Distribution (statement only) and Related Problems.

Estimation of Parameters: Point Estimation, Unbiased, Minimum Variance Unbiased and Consistent Estimators, Interval Estimation, Maximum Likelihood Estimation and Related Problems.

Module IV[10L]

Testing of Hypothesis: Simple and Composite Hypothesis, Critical Region, Level of Significance, Type I and Type II Errors, Power of a Test, Unbiased Tests, Neyman-Pearson Theorem (proof not required), Application to Normal Population, Likelihood Ratio Test (proof not required), Comparison of Binomial and Normal Populations, Testing of Equality of Means χ^2 - Test for Goodness of Fit.

Souvik Basu

Text Books:

1. A First Course in Probability - S. Ross, Collier Macmillan.
2. Statistical Methods (Volume 1 and 2) – N. G. Das, TMH.

Reference Books:

1. Mathematical Statistics – S.C. Gupta and V. K. Kapoor, S.Chand.
2. Engineering Mathematics: Volume IIIA – B. K. Pal & K. Das, U. N. Dhar & Sons Pvt.Ltd.
3. Introduction to Mathematical Statistics - Hogg, McKean and Craig, American Publishing.
4. Statistical Analysis: A Computer Oriented Approach - A. A. Afifi, Academic Press.

Souvik Basu

Paper Name: DIGITAL LOGIC AND COMPUTER ARCHITECTURE LAB					
Paper Code: MCAP1211					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**4**	**4**	**3**

Course Outcomes:

1. Use the concept of Boolean algebra to minimize logic expressions by the algebraic method, K-map method etc.
2. Construct different Combinational circuits like Adder, Subtractor, Multiplexer De-Multiplexer, Decoder, Encoder etc.
3. Design various types of Registers and Counters Circuits using Flip-Flops (Synchronous, Asynchronous, Irregular, Cascaded, Ring, Johnson).
4. Realize different logic circuits using ICs built with various logic families.

Problems related to the following topics:

Topic 1: Realization of AND, OR, NOT, NAND, XOR gates using respective chips. Design AND, OR gates using basic design elements (Diode, Resistance, Transistor etc.),

Topic 2: Implementation of AND, OR, NOT, XOR gates using NAND Gate as a Universal Gate. Realize the following equation using only minimum number of NAND gates
Y = B'C'+ A'BC,

Topic 3: Design Half Adder & Full Adder Circuits using basic Gates,

Topic 4: Design Half Subtractor & Full Subtractor Circuits using basic Gates,

Topic 5: Design Adder-Subtractor Composite circuit,

Topic 6: Design and implementation of 16 bit odd/even parity checker / generator using IC74180,

Topic 7: Design and implementation of encoder and decoder using logic gates and study of IC7445 and IC74147,

Topic 8: Realization of 4:1 & 2:1 MUX Chips. Implement a 8:1 MUX using 4:1 MUXs,

Topic 9: Design S-R, D, J-K Flip-flop,

Topic 10: Design and implementation of 3-bit synchronous up/down counter,

Topic 11: Horizontal expansion of RAM,

Topic 12: Vertical expansion of RAM.

Souvik Basu

<table>
<tr><td colspan="6">Paper Name: DATA STRUCTURES LAB</td></tr>
<tr><td colspan="6">Paper Code: MCAP1212</td></tr>
<tr><td rowspan="2">Contact hrs. per week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>4</td><td>3</td></tr>
</table>

Course Outcomes:

1. To understand linear and non-linear data structures.
2. To understand different types of sorting and searching techniques.
3. To know how to create an application specific data structures.
4. To solve the faults / errors that may appear due to wrong choice of data structure.
5. To analyze reliability of different data structures in solving different problems.

Problems related to the following topics:

Topic 1: 1-D and 2-D array,

Topic 2: Linked List (Singly linked list, Circular Linked List,

Doubly Linked List), Topic 3: Stack and Queue implementation

using array and linked list,

Topic 4: Implementation of different recursive algorithms,

Topic 5: Implementation of Binary Search Tree (insertion, deletion, searching, traversals),

Topic 6: Different searching and sorting algorithms.

Souvik Basu

<table>
<tr><td colspan="6">Paper Name : DBMS I LAB</td></tr>
<tr><td colspan="6">Paper Code: MCAP1213</td></tr>
<tr><td rowspan="2">Contact hrs per week:</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Points</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>4</td><td>3</td></tr>
</table>

Course Outcomes:

1. Apply the RDMS concepts to create various schema and instances in terms tables.
2. Populate the relation of tables with proper restriction through keys.
3. Retrieve specific data from table/s through sub query.
4. Filter data from joining various tables.
5. Use proper data control language to restrict the accessibility of data.

Problems related to the following topics:

Topic 1: Database Creation

- Creating a Database
- Creating aTable
- Specifying Relational Data Types
- Specifying Constraints
- Creating Indexes

Topic 2: Table and Record Handling

- INSERT statement
- Using SELECT and INSERT together
- DELETE, UPDATE, TRUNCATE statements
- DROP, ALTER statements

Topic 3: Retrieving Data from a Database

- The SELECT statement
- Using the WHERE clause
- Using Logical Operators in the WHERE clause
- Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING

Topic 4: Clause

- Using Aggregate Functions
- Combining Tables Using JOINS
- Sub queries

Topic 5: Database Management

- Creating Views
- Creating Column Aliases
- Creating Database Users
  Using GRANT and REVOK

Souvik Basu

Paper Name: DESIGN AND ANALYSIS OF ALGORITHMS					
Paper Code: MCAP2101					
Contact hrs. per week	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [10L]

Introduction
Algorithm specification, performance analysis - time and space complexity, asymptotic notations, Master theorem, Correctness of algorithms.

Divide and Conquer
General method, binary search, quick sort, merge sort, performance analysis; Strassen's matrix multiplication.

Lower Bound Theory
Comparison tree, lower bound on comparison-based sorting, sorting in linear time, counting sort.

Module II [12L]

The Greedy Method
General method, fractional knapsack problem, job sequencing with deadlines, minimum cost spanning trees – Prim's and Kruskal's algorithms.

Dynamic Programming
General method, Shortest path algorithms – Bellman Ford, Floyd Warshall, 0/1 knapsack problem, traveling salesman problem.

Module III [8L]

Traversal and Search Techniques
Breadth first search and traversal, depth first search and traversal, bidirectional search.

Pattern Matching
Brute-force algorithm, Knuth-Morris-Pratt algorithm.

Backtracking
General method, 8 queens problem, graph colouring.

Module IV [10L]

Branch and Bound
General method, least cost search, 15-puzzles problem.

Introduction to NP-completeness
Basic concepts, the classes P, NP, NP-hard and NP-complete, Relative hardness of problems and polynomial time reductions. Satisfiability problem, Clique Decision Problem, Vertex Cover Problem.

Approximation Algorithms
Necessity of approximation scheme, performance guarantee, polynomial time approximation schemes, approximation algorithms for vertex cover, travelling salesman problem.

Text Books:

1. Introduction to Algorithms - Cormen et al, PHI Learning.
2. Fundamentals of Computer Algorithms - Horowitz, Sahni, Orient Longman.

Souvik Basu

Reference Books:

1. The Design and Analysis of Computer Algorithms - Aho, Hopcroft, Ullman, Pearson.
2. Algorithm Design - Kleinberg, Tardos, Pearson.
3. The Art of Computer Programming - Knuth, Pearson.

Souvik Basu

Paper Name: DATA COMMUNICATION & COMPUTER NETWORKS					
Paper Code: MCAP2102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I – Data Communication Fundamentals and Physical Layer [10L]

Overview of Data Communication & Networking
Introduction: Data Communication Systems, Networks, Protocols & Standards, The Internet
Layered Tasks: Utility of Layering, ISO/OSI Reference Model, TCP/IP Reference Model, Comparison between OSI and TCP/IP
Connecting Devices: Repeater, Hub, Bridge, Switch, Router, Gateway
Switching: Overview of – Circuit Switching, Message Switching, Packet Switching, Virtual Circuit Switching

Physical Layer
Signals: Data & Signals, Data Rate Limits, Transmission Impairments
Digital Transmission: Line Coding, Sampling, Transmission Mode
Analog Transmission: Modulation of Digital Data, Modulation of Analog Signals
Multiplexing: FDM, TDM, WDM
Transmission Media: Guided Media, Unguided Media

Module II – Data Link Layer and MAC Sublayer [10L]

Data Link Layer
Framing: Character Stuffing, Bit Stuffing
Error Detection & Correction: Types of Error – Single Bit Error, Error Detection, Error Correction
Flow Control: Stop – And – Wait ARQ, Sliding Window Protocols
Data Link Layer Protocols: HDLC, PPP

Medium Access Sub layer
Random Access: ALOHA, Slotted ALOHA, CSMA/CD, CSMA/CA
Controlled Access: Reservation, Polling, Token Passing
LAN: Ethernet (Traditional, Fast and Gigabit), FDDI, DQDB

Module III – Network and Transport Layer [10L]

Network Layer
Internetworking, Addressing and Routing: Internetworking, Addressing (Internet Address, Classful Addressing, Subnetting), Routing (Static and Dynamic Routing, Distance Vector Routing, Link State Routing)
Network Layer Protocols: ARP, RARP, IP, ICMP and IGMP, IPv6
Network Monitoring and Management: Concepts of Wireshark andSNMP

Module IV – Application Layer and Miscellaneous Topics [10L]

Transport Layer
Process-to-Process Delivery, UDP, TCP: Process to Process Delivery, User Datagram Protocol and Transmission Control Protocol
Congestion Control & Quality of Service: Data Traffic, Congestion and Congestion Control, Quality of Service (QOS), Techniques to improve QOS – Leaky Bucket and Token Bucket Algorithms
Application Layer
Application layer protocols: DNS, Telnet, FTP, SMTP, HTTP, WWW
Introduction to Network Security

Souvik Basu

Text Books:

1. Data Communications & Networking – B.A. Forouzan, TMH.
2. Computer Networks - Andrew S. Tanenbaum, Pearson Education.
3. Data and Computer Communication - William Stallings, PHI.

Reference Books:

1. High speed Networks and Internets - William Stallings, Pearson Education.
2. Cryptography and Network Security - William Stallings, PHI.
3. Computer Networking: A Top Down Approach - Kurose & Ross, Pearson Education.

Souvik Basu

Paper Name: DATABASE MANAGEMENT SYSTEMS II					
Paper Code: MCAP2103					
Contact hrs per week:	L	T	P	Total	Credit Point
	3	1	0	4	4

Module I [10L]

Higher Normal Forms
Overview of Lossless Join Decomposition and Dependency Preservation, Multi-valued Dependency and 4NF, Project-Join Decomposition and 5NF, domain-key and DKNF.

TransactionProcessing
Transaction Concept and State, Implementation of Atomicity and Durability.

Concurrency Control
Executions, Serializability, Recoverability, Implementation of Isolation.
Concurrency Control Techniques: Lock based Protocols, Timestamp based Protocols, Validation based Protocols.
Multiple Granularity, Multiversion Schemes, Deadlock Handling.

Module II [10L]

Recovery Management
Failure Classification, Storage Structure, Recovery and Atomicity, Log-based Recovery, Shadow Paging, Recovery with Concurrent Transactions, Buffer Management, Failure with Loss of Nonvolatile Storage, Advanced Recovery Techniques.

Case Study: RDBMS Architecture
Memory Structures, background processes, disk utilization structures, Starting and stopping the database instance, Creating a Database.

Module III [10L]

Introduction to Procedural Language/Structured Query Language (PL/SQL)
PL/SQL block structure, Variables, Control Structure and iteration, Implicit and Explicit Cursors, Stored procedures and functions, PL/SQL packages, Triggers, Locks.

Module IV [10L]

Introduction to Embedded SQL
Pro*C syntax, Host variables, Static Vs. Dynamic SQL.

Introduction to Distributed Database Management System
Distributed DBMS Architecture, Distributed Query Processing, Distributed Concurrency Control, Distributed DBMS Reliability, Parallel Database Systems.

Introduction to Temporal Database Management System
Valid time and transaction time, Discrete bounded linear flow of time and the temporal structure, System-maintained transaction time, Temporal primary keys, Temporal queries at current time, Time points in the past or future or over durations.

Souvik Basu

Introduction to Object-Oriented Database Management System

Data types and Object, Evolution of Object Oriented Concepts, Characteristics of Object Oriented Data Model.

Object Hierarchies – Generalization, Specialization, Aggregation.

Object Schema. Inter-object Relationships, Similarities and difference between Object Oriented Database model and Other Data models.

Concept of Grid, Cloud and Graph database.

Text Books:

1. Database System Concepts – A.Silberschatz, Henry F. Korth, S. Sudarshan, TMH.
2. An Introduction to Database Systems - C.J. Date, Pearson.

Reference Books:

1. Fundamentals of Database Systems – Ramez Elmasri, Shamkant B. Navathe, Pearson.
2. Database Systems: The Complete Book - Jeffrey D. Ullman, Jennifer Widom, PHI.
3. Distributed Databases Principles and Systems - Ceri, Pelagatti, TMH.

Souvik Basu

<table>
<tr><td colspan="6">Paper Name: OPERATING SYSTEMS</td></tr>
<tr><td colspan="6">Paper Code: MCAP2104</td></tr>
<tr><td rowspan="2">Contact hrs. per week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Point</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td><td>4</td></tr>
</table>

Module I [8L]

Introduction

Introduction to Operating Systems, Concept of batch-processing, single and multi-programming, single and multi-processing, multi-tasking, real time, distributed and parallel processing.

Process and Scheduling

Concept of process, state diagram, process control block, Scheduling-short, medium and long term scheduling.

CPU Scheduling – criteria, types of scheduling, non-preemptive and preemptive scheduling algorithms like: First Come First Serve (FCFS), Shortest Job First/Next (SJF/N), Shortest Remaining Time Next (SRTN), Round Robin (RR), Highest Response Ratio Next (HRRN), Priority based scheduling, Multilevel queue scheduling, Multilevel feedback queue scheduling.

Threads

Concept, process vs thread, kernel and user threads, multi-threading models.

Module II [12L]

Inter-process Communication

Shared memory approach, message passing, FIFO, concept of semaphore, critical region, monitor.

Process Synchronization

Concepts, race condition, mutual exclusion, critical section problem and its solutions; synchronization tools - semaphore, semaphore with queue, monitor; discussion of synchronization problems like producer-consumer, readers-writers, dining philosophers, sleeping-barber.

Module III [10L]

Deadlock

Characterization, Prevention, avoidance, detection, recovery.

Memory Management

Address space and address translation; memory partitioning - static and dynamic, different types of fragmentation, swapping, paging, segmentation, virtual memory concepts, demand paging, performance, page replacement algorithms – FIFO, LRU, Optimal page replacement, variants of LRU; frame allocation, thrashing, working set strategy.

Module IV [10L]

Disk Management

Disk structure, disk scheduling algorithms – FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK; disk formatting, boot block, bad blocks.

File Systems

File and operations on it, file organization and access; file allocation; directory structures, file allocation methods – contiguous, linked, indexed; free space management – bit vector, linked list, grouping.

Souvik Basu

I/O Management

I/O hardware, polling, interrupts, DMA, application I/O interface – block and character devices, network devices, clocks and timers, blocking and non-blocking I/O; kernel I/O subsystem – scheduling, buffering, caching, spooling, error handling.

Protection and Security

Concepts of domain, Access matrix and its implementation, access control. Security concepts, program threats, system threats, threat monitoring, cryptography as security tool, user authentication.

Text Books:

1. Operating System Concepts - Silberschatz, Galvin, Gagne, Wiley.
2. Operating Systems Design and Implementation - Andrew S. Tanenbaum, Prentice Hall.

Reference Books:

1. Operating Systems -Dietel, Dietel, Choffnes, Prentice Hall.
2. Operating Systems Internals and Design Principles - Stallings, Pearson.

Souvik Basu

<table>
<tr><td colspan="6">Paper Name: ALGORITHMS LAB</td></tr>
<tr><td colspan="6">Paper Code: MCAP2111</td></tr>
<tr><td rowspan="2">Contact hrs. per week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Point</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>4</td><td>3</td></tr>
</table>

Programs related to

- (Divide and Conquer) Binary Search, Merge Sort, Quick Sort, finding maximum and minimum element from an array of integers
- (Greedy method) Minimum cost spanning trees by Prim's and Kruskal's algorithm, job sequencing with deadlines
- (Dynamic programming) single source shortest path – Bellman Ford, all pair shortest path – Floyd Warshall, traveling salesman problem
- (Graph traversal) BFS, DFS
- (Pattern matching) brute-force, KMP
- (Backtracking) 8 queens problem
- (Branch and Bound) 15 puzzles problem

Souvik Basu

Paper Name: UNIX AND NETWORK PROGRAMMING LAB					
Paper Code: MCAP2112					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	0	**0**	**4**	**4**	**3**

UNIX Fundamentals

1. Basic UNIX Commands
2. Writing Shell Scripts

Network Programming on the following *(To be implemented in Java/C/C++)*

1. IPC: a) Pipes b) FIFO
2. File transfer using message queue form of IPC
3. TCP sockets (like date and time server & client, echo server & client, etc.)
4. UDP sockets (like simple DNS)
5. Raw sockets (like packet capturing and filtering)
6. Sliding window protocol and cyclic redundancy check
7. Routing protocols
8. Study of TCP/UDP performance
9. TCP client and server application to transfer file
10. UDP client and server application to transfer a file
11. RPC

Testbed Development and Simulators

1. Creating a LAN
2. Use of Network Simulators for Network Modeling (basic ideas/ demonstration only)

Reference Books:

2. Advance UNIX Programming - Richard Stevens, Pearson Education.
3. Advance UNIX Programming - N.B. Venkateswarlu, BS Publication.

Souvik Basu

Paper Name: DBMS II LAB					
Paper Code: MCAP2113					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	0	**0**	**4**	**4**	**3**

Problems on -

- SQL

  Creation of a database objects with constraints. Deletion and modification of database objects. Performing Insertion, Deletion, Modification, Alteration and Viewing records based on conditions.

  Creation of Views, Synonyms, Sequence, Indexes, Save points.
- PL/SQL overview
  - Structure of PL/SQL block.
  - Using PL/SQL variables, taking user input and displaying the output.
  - PL/SQL Control structures(Conditional control, Iterative control, Sequential control)
  - Built-in PL/SQL functions
  - PL/SQL composite datatype (Tables, ROWTYPE)
  - Subprograms

    Procedures

    Functions
  - Cursor Management

    Implicit Cursor

    Explicit Cursor

    Cursor for-loop
  - Database Triggers
  - Error Handling
  - Packages

Reference Books:

1. SQL, PL/SQL The Programming Language of Oracle – Ivan Bayross, BPB.

Souvik Basu

Paper Name: SOFTWARE ENGINEERING					
Paper Code: MCAP2201					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [10L]

Introduction
Introduction to software engineering, importance of software, the software evolution, software characteristics, software applications, software crisis: problem and causes.

Software Development Life Cycle
Waterfall model, incremental and evolutionary process models, specialized Model – The Unified Process, agile process, and agile models.

Software Requirement Specification
Problem analysis, requirement elicitation and validation, requirements modeling: scenarios, information and analysis classes, flow and behavioral modeling, documenting Software RequirementSpecification (SRS).

Module II [8L]

Software Cost Estimation
Overview of software estimation – size, effort, duration and cost. Size estimation methods – Lines of Code (LOC) and Function Points (FP). Estimation of effort and duration based on size and productivity. Constructive Cost Model (COCOMO) – Basic, Intermediate, Detailed.
COCOMO II.

System Design
Design concepts, design models for architecture, component, data and user interfaces; Problem partitioning, abstraction, cohesiveness, coupling, top down and bottom up design approaches.

Module III [12L]

Structured Analysis and Design
Process model using Data Flow Diagram (DFD) with examples. Data dictionary, decision tree, decision table with examples. Data model using Entity Relationship Diagram (ERD) with examples.

Object Oriented Analysis and Design
OOAD basic concepts, Unified Modeling Language (UML) – different types of diagrams for different views of system, User view – Use case diagram with examples, Structural views – Class diagram with examples, Behavioral View – sequence, collaboration, Activity and State Chart Diagrams with examples. Implementation view-Component diagram, Environmental view- Deployment diagram, Functional versus Object Oriented Approach.

Coding
TOP-DOWN and BOTTOM-UP structure programming, information hiding, programming style, internal documentation, verification.

Module IV [10L]

Software Testing

Souvik Basu

Levels of testing, functional testing, structural testing, test plan, test case specification, software testing strategies, verification &validation, unit and integration testing, Top Down and Bottom Up integration testing, Alpha & Beta Testing, White box and black box testing techniques, system testing and debugging.

Software Maintenance

Types of maintenance – Corrective, Preventive, Adaptive. Change management and maintenance process.

Software Quality Assurance

Software Configuration Management, overview of software quality control and quality assurance, ISO 9000 certification for software industry, SEI Capability Maturity Model (CMM) and comparison between ISO & SEI CMM.

Overview of technical metrics for software and CASE tool.

Text Books:

1. Software Engineering: A Practitioner's Approach - Roger S. Pressman, TMH.
2. Fundamentals of Software Engineering – Rajib Mall, PHI.

Reference Books:

1. Software Engineering - P. Fleeger, Prentice Hall.
2. Analysis and Design of Information System - J. A. Senn, Mc Graw Hill College.
3. Software Engineering - Sommerville, Addison Wesley.
4. Software Testing Tools - K. V. K. K Prasad, Dreamtech Press.

Souvik Basu

Paper Name: WEB TECHNOLOGY					
Paper Code: MCAP2202					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [10L]

Introduction

Internet Principles, concept of WWW, internet protocols and applications, web browser and web servers, features of Web 2.0

Web Design

Basic web concepts, Client/Server model, concepts of effective web design, web design issues including browser, display resolution, page layout and linking, user centric design, sitemap.

Dynamic Web Pages

The need of dynamic web pages; Comparative studies of different technologies of dynamic page creation.

HTML

Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, meta tags, character entities, frames and frame sets, browser architecture and web site structure. Overview and features of HTML5.

Module II [10L]

Style sheets

Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of CSS3

Extensible Markup Language (XML)

Introduction, tree, syntax, elements, attributes, validation, viewing. XHTML in brief.

HTTP

Message, request, response, methods, status codes.

Module III [10L]

JavaScript

CGI concepts, data types, variables, operators, conditional statements, array object, date object, string object.

PHP

Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string processing and regular expressions, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP.

Module IV [10L]

PHP and MySQL

Open Source Web server, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, updating and deleting data and tables, PHP myadmin and database bugs.

Souvik Basu

Network security threats and techniques

Threats: Malicious code, eavesdropping, spoofing, denial of service attacks. Techniques: VPN, password and authentication, firewall, proxies.

Text Books:

1. Web Technologies – Uttam Roy, Oxford.
2. Learning PHP, MySQL & JavaScript: With JQuery, CSS & HTML5 – Robin Nixon, Shroff Publishers.

Reference Books:

1. HTML & CSS: Design and Build Web Sites - Jon Duckett, John Wiley & Sons.
2. PHP 6 and MySQL 5 for Dynamic Web Sites - Larry Ullman, Peachpit Press.
3. Web Technologies (Black Book) -Kogent Learning Solutions Inc, Dreamtech Press.
4. Internet Technology & Web Design – Satish Jain, BPB Publications

Souvik Basu

Paper Name: COMPUTER GRAPHICS					
Paper Code: MCAP2203					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [10L]

Introduction
Basics of computer graphics, real world usage of computer graphics, classification of applications, display technologies, raster-scan systems, video controller, random-scan display processor, graphics input devices, graphics software and standard.

Graphics Primitives
Scan converting points.
Scan converting lines – DDA algorithm, Bresenham's algorithm, Midpoint algorithm.
Scan converting circles – Midpoint algorithm.
Scan converting ellipse – Midpoint algorithm.
Fill area primitives–boundary-fill and flood-fill, scan-line polygon fill.

Module II [10L]

Affine Transformation (2D)
2D translation, rotation and scaling, homogeneous coordinates and matrix representation, composite transformations, reflection and shearing.

Viewing and Clipping
Viewing pipeline and coordinates system, window-to-viewport transformation, point clipping.
Line clipping algorithms - Cohen-Sutherland, Midpoint subdivision, Cyrus-Beck algorithms.
Polygon clipping – Sutherland Hodgeman algorithm, Weiler Atherton algorithm.

Module III [10L]

3D Transformation and Viewing
3D translation, rotation and scaling, composite transformations.
Projections - perspective and parallel projections, specifying an arbitrary 3D view.

Curves and Surfaces
Polygon surfaces, curved lines and surfaces, parametric cubic curves – Hermite curves, Bezier curves, Uniform Nonrational B-Splines, Nonuniform Nonrational B-Splines, comparisons of cubic curves, introduction to parametric bicubic surfaces.

Module IV [10L]

Visible Surface Detection
Classification of visible surface detection algorithms, back face detection, z-Buffer algorithm, scan-line algorithms, area subdivision algorithm, octree algorithms, visible-surface ray tracing.

Illumination and Shading
Illumination methods (ambient, diffused and specular reflection), constant and interpolated shading methods (Gouraud, Phong).

Text Books:

1. Computer Graphics C Version - D. Hearn and P. Baker, Pearson Education.
2. Computer Graphics - Xiang and Plastock, Schaum Outline Series.

Souvik Basu

Reference Books:

1. Procedural Elements of Computer Graphics - Rogers, TMH.
2. Mathematical Elements for Computer Graphics - Rogers, TMH.
3. Computer Graphics - Andries van Dam, James D. Foley, John F. Hughes, Steven K. Feiner, Pearson Education.
4. Introduction to Computer Graphics & Multimedia – Mukhopadhyay and Chattopadhyay, Vikas Publishing House.

Souvik Basu

Paper Name: INTELLIGENT SYSTEMS					
Paper Code: MCAP2204					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [10L]

Introduction
Introduction to Intelligent Systems: concept, typical problems, practical impact, approaches andlimits.

Intelligent Agents
Definitions of a rational agent, reflex, model-based, goal-based, and utility-based agents, agent environment.

Problem Solving using Search -(Single agent)
State space search, explicit &implicit state space; Uninformed Search- search strategies, search tree, Breadth First Search, Uniform-cost search, Depth First Search; Informed search strategies – introduction, Hill Climbing search, Best First Search, Simulated Annealing, Genetic Algorithm Search, A* Search.

Module II [10L]

Problem Solving using Search-(Two agents)
Adversarial Search- and-or graph, AO* search, two agent games – minmax & game trees, refining minmax, Alpha-Beta pruning.

Constraint satisfaction problems (CSP)
Representation of CSP, solution of CSP, variable and value ordering, heuristic search in CSP.

Knowledge Representation and Logic (Propositional Logic)
Knowledge representation and reasoning, inference, rules of inference, using inference rules to prove a Query/Goal/Theorem, soundness and completeness.

Module III [10L]

Knowledge Representation and Logic (First Order Logic)
First Order Logic, unification, semantics, soundness, completeness, consistency, satisfiability; Inference in First Order Logic – resolution, proof as search, proof strategies, non-monotonic reasoning.

Knowledge Representation and Logic (Rule based Systems)
Rule Based Systems, Horn Clause Logic, Backward Chaining, Forward chaining, expert systems.

Other Representation Formalisms
Knowledge representation formalisms, semantic networks, inference in semantic networks; frame, inference in frame; script, inference in script.

Module IV [10L]

Planning
Introduction to planning, logic based planning, planning systems - representation of states and goals, representation of action; Planning algorithm - planning as search, Partial-Order planning, Plan-Space planning algorithms.

Souvik Basu

***Reasoning with Uncertainty* (*Probabilistic reasoning*)**

Reasoning with uncertain information- Probabilistic reasoning, review of probability theory; Probabilistic inference rules; Bayesian Networks - semantics of Bayesian networks, learning of Bayesian Network parameters, inferencing in Bayesian Networks, approximate inferencing in Bayesian Networks.

***Reasoning with Uncertainty* (*Fuzzy Reasoning*)**

Reasoning with uncertainty, the problem: Real-World Vagueness, Historic Fuzziness; Fuzzy Sets: Basic Concepts, operations on Fuzzy sets; Fuzzy reasoning - Fuzzy inferencing; applications.

Text Books:

1. Introduction to Artificial Intelligence and Expert Systems - Dan W. Patterson, PHI.
2. Artificial Intelligence - A Modern Approach, S. Russell and P. Norvig, Pearson Education.

Reference Books:

1. Artificial Intelligence - Elaine Rich and Kelvin Knight, TMH.
2. Artificial Intelligence and Soft Computing Behavioral and Cognitive Modeling of the Human Brain - Amit Konar, CRC Press.
3. Artificial Intelligence: A New Synthesis – N.J. Nilsson, Morgan Kaufmann.
4. Fundamentals of Artificial Intelligence and Expert Systems – V.S. Janakiraman, Macmillan.

Souvik Basu

Paper Name: SOFTWARE ENGINEERING LAB					
Paper Code: MCAP2211					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	0	**0**	**4**	**4**	**3**

Problems related to

1. Identifying requirements from problem statements
2. Estimation of project metrics
3. Modeling UML Use Case Diagrams and capturing Use Case scenarios
4. E-R modeling from the problem statements
5. Modeling Data Flow Diagrams
6. Identifying domain classes from the problem statements
7. Statechart and Activity Modeling
8. Modeling UML Class Diagrams and Sequence Diagrams
9. Estimation of Test Coverage Metrics and Structural Complexity
10. Designing test suites using tools

Souvik Basu

Paper Name: WEB TECHNOLOGY LAB					
Paper Code: MCAP2212					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	0	**0**	**4**	**4**	**3**

HTML
1. Web page design using tables, frames, header, footer and menu.
2. Creating a form with support for redirection to other page(s).
3. Designing CSS with Bootstrap features to allow for responsive web content.

JAVASCRIPT
1. Create dynamic web pages by modifying features of HTML tags.
2. Validate the fields of a form.
3. Create simple animations.

XML
1. How to write a XML document.
2. How to validate XML document.

PHP
1. Writing methods to implement GET and POST requests.
2. Implementing cookies and sessions.
3. Writing PHP and HTML in open source environment.

DATABASE CONNECTIVITY
1. Connecting to database in web server.
2. Query processing to retrieve data from database and update tables.

Souvik Basu

Paper Name: GRAPHICS LAB					
Paper Code: MCAP2213					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	0	**0**	**4**	**4**	**3**

The following set of experiments in this Lab will be conducted using C / OPENGL / JAVA in Windows / Linux Environment.

1. Implementation of algorithms for drawing 2D primitives –
   - Line (DDA, Bresenham, Midpoint)
   - Circle (Midpoint)
   - Ellipse (Midpoint).
2. Implementation of region filling algorithms – Boundary fill, flood fill.
3. 2D Geometric transformations –
   - Translation
   - Rotation
   - Scaling
   - Reflection
   - Shear
   - Composite 2D Transformations
4. Implementation of algorithms for line clipping –
   - Cohen-Sutherland
   - Midpoint subdivision
   - Cyrus-Beck
5. Drawing of curves – Cubic Bezier, B-Spline
6. Mini Project with animation

Souvik Basu

Paper Name: SYSTEM ADMINISTRATION USING LINUX					
Paper Code: MCAP3150					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [8L]

Introduction to Linux

Basic idea on proprietary, Open source, Free software; Introduction of various Linux variants and comparative study; Basic architecture of Linux system. Linux file system, Boot block, Super block, Inode table, Data blocks, Linux file access, Storage files, Standard directories, LILO, GRUB boot loader; Installation of Linux system, init and run levels.

Module II [11L]

Linux Basics

Login process, Creating user account and group, Getting help. Services and process, Files and file system, Working with files: Reading, Searching, Copying, Moving, Renaming, Deleting, Linking, and Editing files; Disk related commands. Various types of shell available in Linux and their comparisons, Shell programming in bash.

Module III [10L]

System Administration

Common administrative tasks, Identifying administrative files – Configuration and log files, Role of system administrator, Managing user accounts and groups, Creating and mounting file system, Checking and monitoring system performance, File security and permissions, Concepts of Super user; Getting system information. Backup and restore files, Reconfiguration hardware with kudzu, Installing and removing packages in Linux.

Module IV [11 L]

Networking in Linux

Installation and configuration of a simple LAN; Installation and configuration of: Proxy server (Squid), DNS server (BIND), Mail server, Web server (Apache), File server (Samba), DHCP server; Installation and configuration of SSH server and client, FTP server and client. Setting up Linux for firewalling, IP accounting.

Text Books:

1. Linux Administration: A Beginner's Guide - Shah, TMH.
2. LINUX: The Complete Reference - Petersen, TMH.

Reference Books:

1. Red Hat LINUX-Administrator's Guide - Cox, PHI.
2. LINUX Network Administrator's Guide - Kirch, SPD/O' REILLY.
3. Essentials System Administration - Frisch, SPD/O'REILLY.
4. Red Hat Linux Networking & System Administration - Terry Collings & Kurt Wall, Wiley.

Souvik Basu

<table>
<tr><td colspan="6">Paper Name: ADVANCED JAVA</td></tr>
<tr><td colspan="6">Paper Code: MCAP3151</td></tr>
<tr><td rowspan="2">Contact hrs. per week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Point</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td><td>4</td></tr>
</table>

Module I [10L]

GUI Programming: Swing

Swing components and containers, Layout managers, Menu, Event-Driven programming, Event handling mechanism, Event delegation model, Event classes, Event sources, Event listeners, Adapter classes.

Database Programming: JDBC

Introduction to JDBC, JDBC drivers & architecture, Different approaches of connection, Establishing database connection and executing SQL statements, JDBC prepared statements, JDBC data sources.

Module II [10L]

Server Technologies: Servlet

Web application basics, Architecture and challenges of web application, Enterprise Architecture styles: Single tier, 2-tier, 3-tier, n-tier, Relative comparison of the different layers of architectures.

Introduction to servlet, Servlet life cycle, Developing and deploying servlets, Exploring deployment, Descriptor (web.xml), Handling Request and Response, Servlet Chaining, Session tracking and management, Dealing with cookies, Servlet Listeners.

Module III [10L]

Server Technologies: JSP

Comparison between JSP & servlet, Basic JSP architecture, JSP life cycle, JSP tags and expressions, Role of JSP in MVC-2, JSP with database, JSP implicit objects, Tag libraries, JSP Expression Language (EL), Using Custom tag, Exception handling, Session management, Directives.

RMI (Remote Method Invocation)

RMI overview, RMI architecture, Example demonstrating RMI

Module IV [10L]

Enterprise JAVA Beans

Enterprise Bean overview, Types of Enterprise Beans, Advantages of Enterprise Beans, Enterprise Beans life cycle, Working with Session Beans, Statefull vs. Stateless Session Beans, Working with Entity Beans, Message Driven Beans.

Text Books:

1. Advanced Java: Platform How to Program – Harvey M. Deitel, Paul J. Deitel and Sean E. Santry, Prentice Hall.
2. Professional JAVA Server Programming – Allamaraju and Buest, SPD Publication.

Souvik Basu

Reference Books:

1. Beginning J2EE 1.4 – Ivor Horton, SPD Publication.
2. Advanced Programming for JAVA 2 Platform – Austin and Pawlan, Pearson
3. Internet & Java Programming - Krishnamoorthy and S. Prabhu, New Age Publication
4. Advanced Java: Idioms, Pitfalls, Styles, and Programming Tips – Chris Laffra, Addison Wesley.

Souvik Basu

Paper Name: IMAGE PROCESSING					
Paper Code: MCAP3152					
Contact hrs. per week	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [8L]

Introduction
Overview of image processing, Application area of image processing, Digital image representation, Fundamental steps in image processing, Components of an image processing system. Sampling and quantization. Basic relationship between pixels – Neighbours, Adjacency, Connectivity, Regions, Boundaries and distance measures. Introduction to Fourier transform and Discrete Fourier transform, Properties of 2D Discrete Fourier transform.

Module II [**12L**]

Image Enhancement
Spatial domain image enhancement techniques: Basic intensity transformations – Negative, Log, Power-law, Piecewise linear transformations, Histogram based techniques (histogram equalization, histogram matching). Spatial filtering: Smoothing (linear and non-linear), Sharpening (gradient and Laplacian), Unsharp masking and highboost filtering.
Enhancement in the frequency domain – Basics of filtering in frequency domain, Smoothing and sharpening filters: Ideal, Butterworth, Gaussian. Homomorphic filtering. Selective filtering.

Module III [10L]

Image Restoration
Model of image degradation/restoration process, Noise models, Image restoration in presence of noise only – Spatial filtering, Periodic noise reduction by frequency domain filtering – Bandreject and bandpass filtering. Inverse filtering, Least mean square error filtering, Constrained least squares filtering.

Image Compression
Fundamentals- Redundancy, Measuring image information, Fidelity criteria, Image compression models.
Compression methods: Huffman coding, Arithmetic coding, LZW coding, Run length coding, Bit plane coding, Predictive coding.

Module IV [10L]

Image Segmentation
Detection of discontinuities, Edge, Line and point detection. Edge linking and boundary detection - Local processing, Global processing via Hough transform. Thresholding – Global, Optimum, Multiple and variable. Region based segmentation: Growing, Splitting and merging.

Image Representation
Representation: Chain codes, Polygonal approximation. Boundary descriptors. Regional descriptors.

Text Books:
1. Digital Image Processing - Gonzalez, Woods, Pearson.
2. Fundamentals of Digital Image Processing - Jain, Pearson.

Souvik Basu

Reference Books:

1. Principles of Digital Image Processing: Advanced Methods – Burger, Burge, Springer.
2. Digital Image Processing and Analysis - Chanda, Majumder, PHI.
3. Image Processing Principles and Applications - Acharya and Ray, Wiley.
4. Image Processing, Analysis & Machine Vision - Sonka, Hlavac, Boyle, Cengage Learning.

Souvik Basu

Paper Name: ADVANCED JAVA LAB					
Paper Code: MCAP3156					
Contact hrs. per week	**L**	**T**	**P**	**Total**	**Credit Point**
	0	**0**	**4**	**4**	**3**

Programs related to

- Programming using Swing and Event handling
- JDBC connectivity
- Servlet programming
    - RequestDispatcher
    - sendRedirect
    - GET and POST methods
    - Cookies
    - Sessions
- JSP design
    - page, include, taglib
    - scripting elements
- Remote Method Invocation: programs to provide the mechanism by which the server and the client communicate and pass information back and forth
- JavaBeans
    - useBean action tag
    - getProperty
    - setProperty

programs to implement to dynamically generate HTML, XML or other types of documents in response to a web client request

Souvik Basu

<table>
<tr><td colspan="6">Paper Name: IMAGE PROCESSING LAB</td></tr>
<tr><td colspan="6">Paper Code: MCAP3157</td></tr>
<tr><td rowspan="2">Contact hrs. per week</td><td>L</td><td>T</td><td>P</td><td>Total</td><td>Credit Point</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>4</td><td>3</td></tr>
</table>

1. Reading, writing, and displaying images, Conversion from RGB to gray images.
2. Intensity transformations – Image negative, Log, Power-law.
3. Contrast stretching.
4. Image histogram and histogram equalization.
5. Spatial filtering - Smoothing: Linear and non-linear, Sharpening.
6. Fourier transformation of images.
7. Frequency domain filtering.
8. Point detection, Line detection and edge detection.
9. Thresholding – Local, Global, Optimum, Multiple and variable.
10. Region growing, Splitting and merging.

Souvik Basu

Paper Name: CRYPTOGRAPHY AND NETWORK SECURITY					
Paper Code: MCAP3160					
Contact hrs. per week	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [10L]

Introduction to Security
Security goals, Threats, Vulnerabilities and attacks, Types of attacks, Security services and mechanisms.

Mathematical Foundation
Number theory, Congruencies, Modular Arithmetic, Chinese Remainder theorem, Fermat and Euler's theorem, Finite Fields, Discrete Logarithm.

Module II [10L]

Symmetric Key Encryption
Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers, Simple DES, DES analysis, Double and Triple DES, RC4, RC5, AES.

Module III [10L]

Asymmetric Key Encryption and Hash Functions
Diffie-Hellman Key Exchange, EIGamal Public Key Encryption, RSA, Elliptic Curve based cryptography, SHA4, SHA5, MD5, Digital signature.

Module IV [10L]

Network Security Applications
Authentication applications: Kerberos, X509, Public Key Infrastructure. Electronic mail security – PGP, S/MIME. IP and Web security – IPSec, SSL, TLS, SET.

System Security
Intruders, Malicious software, Viruses, Worms, Bots, Rootkits, Firewalls, Security standards.

Text Books:
1. Cryptography and Network Security: Principals and Practice – William Stallings, Pearson Education India.
2. Cryptography and Network Security – Foruzan and Mukhopadhyay, McGraw Hill Education.

Reference Books:
1. Cryptography: Theory and Practice – D.R. Stinson, CRC Press.
2. Applied Cryptography – B.Schneier, Wiley.
3. Network Security: Private Communication in a Public World – by Charlie Kaufman, Radia Perlman and Mike Speciner, Prentice Hall India.
4. Network Security Essentials: Applications and Standards – William Stallings, Pearson Education.

Souvik Basu

Paper Name: MOBILE COMPUTING					
Paper Code: MCAP3170					
Contact hrs. per week	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [10L]

Introduction

Introduction to mobile computing, Mobile communication vs. wireless communication, Mobile computing applications, Characteristics of mobile computing, Structure of mobile computing application.

Wireless MAC Protocols

Wireless MAC issues: Motivation for a specialized MAC (Hidden and exposed station problem, Near-far station), Channel assignment scheme (static and dynamic), Random assignment schemes, Reservation based schemes.

Module II [10L]

Mobile Network Layer

Mobile IP (Goals, Assumptions, Entities and terminology), IP packet delivery, Agent advertisement and discovery, Registration, Route optimizations.

Mobile Transport Layer

Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast Retransmit/Fast Recovery, Transmission /Time-out Freezing, Selective Retransmission, Transaction Oriented TCP.

Module III [10L]

Mobile Telecommunication Systems

Global System for Mobile Communication (GSM), General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS), Long Term Evolution (LTE).

Module IV [10L]

Mobile Ad-Hoc Networks

Ad-Hoc basic concepts, Characteristics, Applications, Design issues, Routing, Essential of traditional routing protocols, Popular routing protocols, Security issues in MANETs.

Text Books:

1. Fundamentals of Mobile Computing – P. K. Pattnaik, R. Mall, PHI Learning Pvt. Ltd.
2. Mobile Communications – J. H. Schiller, Pearson Education.

Reference Books:

1. Principles of Mobile Computing – U. Hansmann, L. Merk, M. S. Nicklons and T. Stober, Springer.
2. Introduction to Wireless and Mobile systems – D. P. Agarval, Qing and An Zeng, Thomson Asia Pvt Ltd.
3. Mobile Cellular Telecommunications-Analog and Digital Systems – William.C.Y.Lee, Tata Mc Graw Hill Edition.

Souvik Basu

Paper Name: SOFT COMPUTING					
Paper Code: MCAP3171					
Contact hrs. per week	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [8L]

Introduction
Introduction to soft computing, Different tools and techniques, Usefulness and applications.

Genetic algorithm (GA)
Basic concepts, Working principle, Encoding, Fitness function, Genetic modeling: Inheritance, Selection, Cross over, Mutation, Bitwise operator, Convergence of GA, Overview of Multi-Objective Genetic Algorithm (MOGA).

Module II [10L]

Neural Network
Structure and function of biological neuron, Artificial neuron, Definition of Artificial Neural Network (ANN), Taxonomy of neural net, Difference between ANN and human brain, Characteristics and applications of ANN, Single layer network, Multilayer Perceptron(MLP), Linear separability, Different activation functions, Back propagation algorithm, Basic concept of convolution and recurrent neural network, Applications of neural networks.

Module III [12L]

Fuzzy sets and Fuzzy logic systems
Overview of classical set theory, Fuzzy sets and Fuzzy relations, Fuzzy set operations, Properties of Fuzzy sets, Cardinality, Properties of Fuzzy relations.

Membership functions
Features of membership functions, Standard forms and boundaries, Standard Fuzzification methods.

Fuzzy to Crisp conversions
Lambda cuts for Fuzzy sets, Fuzzy relations, Defuzzification methods, Overview of classical predicate logic, Fuzzy logic, Approximate reasoning and Fuzzy implication.

Fuzzy rule based systems:
Linguistic hedges, Fuzzy rule based system–Aggregation of Fuzzy rules.

Module IV [10L]

Rough Set
Introduction to Rough sets, Decision table, Indiscernibility relations and set approximation, Reducts & Core, Rough approximation, Decision matrix, Application of Rough set.

Evolutionary Algorithm
Introduction, Key principles of swarm, Overview and application of - Ant colony optimization (ACO), Particle swarm optimization (PSO), Artificial bee colony optimization (ABC)

Souvik Basu

Text Books:

1. Fuzzy logic with Engineering Applications - Timothy J. Ross, John Wiley and Sons.
2. Neural Networks, Fuzzy Logic and Genetic Algorithms - S.Rajasekaran and G.A.V.Pai, PHI.

Reference Books:

1. Soft Computing and Its Applications, Volume One: A Unified Engineering Concept, Volume 1 – Kumar S. Ray, CRC Press.
2. Genetic Algorithms in search, Optimization & Machine Learning - David E. Goldberg, Pearson India.
3. Artificial Neural Networks - B. Yegnanarayana, PHI.
4. Soft computing - Dilip K. Pratihar, Alpha Science International.

Souvik Basu

Paper Name: COMPILER DESIGN					
Paper Code: MCAP3182					
Contact hrs. per week	L	T	P	Total	Credit Point
	3	1	0	4	4

Module I [10L]

Compilation Basics
Analysis of the source program, Different phases of compilation. One /Two pass compilers.

Lexical Analysis
The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering. Specifications of a token, Token recognition, Lexical Analyzer Generator (Lex).

Finite Automata
Conversion from Regular Expression (RE) to NFA, NFA to DFA, Regular expression to DFA.

Module II [10L]

Language and Grammar
Chomsky Classification of grammar, Context free grammars.

Syntax Analysis
The role of a parser, Top down parsing, Nonrecursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators(YACC).
Error Recovery strategies for different parsing techniques.

Module III [10L]

Syntax Directed Translation
Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.

Run Time Environment
Run time environments Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, Dynamic storage allocation techniques.

Module IV [10L]

Intermediate Code Generation
Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).

Souvik Basu

Code Optimization & Final Code Generation

Code optimization introduction, Basic blocks & flow graphs, Optimization of basic blocks, Principle sources of optimization, Loops in flow graph, Peephole optimization. Code generations Issues in the design of code generator, A simple code generator, Register allocation & assignment.

Text Books:

1. Compiler Design - Aho, Ullman, Sethi, Lam, Pearson.
2. Compiler Design in C - Allen Holub, Prentice Hall.

Reference Books:

1. Algorithms for Compiler Design - O.G. Kakde, Laxmi Publications.
2. Engineering a Compiler, Keith Cooper, Linda Torczon – Morgan Kauffman.
3. Compiler Design - Santanu Chattopadhyay, PHI.
4. The Compiler Design Handbook Optimizations And Machine Code Generation - Y.N. Srikant, Priti Shankar, CRC Press.

Souvik Basu

Paper Name: ECOMMERCE AND ERP					
Paper Code: MCAP3183					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit Point**
	3	**1**	**0**	**4**	**4**

Module I [10L]

Introduction to E-Commerce

Definition, Scope, Advantages and disadvantages of e-commerce, Electronic Commerce applications. E-Commerce Organization model based on transaction type, Model based on Transaction Party. E strategy: Overview, Strategic methods for developing E-commerce. Four C's: (Convergence, Collaborative computing, Content Management & Call Center). Electronic payment systems: Digital payment systems; First virtual Internet payment system; Cyber cash model.

Module II [9L]

E-Payment Mechanism

Payment through card system, Electronic Data Interchange (EDI): Concepts, Benefits and applications; EDI model, EDI protocols (UN EDI FACT / GTDI, ANSI X—12), Data encryption (DES / RSA). Risk of e-commerce: Overview, Security for e-commerce, Security standards, Firewall, Cryptography, Key management, Password systems, Digital certificates, Digital signatures.

Module III [10L]

Enterprise Resource Planning (ERP)

Introductory concepts: Scope, Benefits, Importance of ERP in the E-Business era. Supply Chain Management: Role of ERP in SCM, ERP features and capabilities. Overview of commercial software, Re-engineering work processes for IT applications, Business process redesign, Knowledge engineering and data warehouse, Advantages & disadvantages of ERP.

Module IV [11L]

ERP Business Modules

Introduction to basic modules of ERP system. Resource management in global scenario. Workflows in ERP, ERP and Corporate Portal, ERP implementation: ERP Life Cycle Model, Information systems planning, Critical Success Factors of ERP implementation, Extended ERP applications: Customer Relationship Management, Supply Chain Management, Product Life Cycle Management. Case Study: ERP as an Integrated System.

Text Books:

1. Electronic Commerce - Peter Loshin, John R. Vacca, Charles River Media.
2. Concepts in Enterprise Resource Planning - Ellen Monk, Bret Wagner, CENGAGE Learning India.

Reference Books:

1. E-Commerce - K.K. Bajaj, D. Nag, McGraw-Hill Education.
2. E-Commerce An Indian Perspective - P.T. Joseph, PHI Publication.
3. Electronic Commerce-Technology and Application – Bhaskar Bharat, McGraw-Hill Education.
4. Enterprise Resource Planning - Mary Sumner, PHI Learning India Pvt. Ltd.

Souvik Basu