Applied Electronics & Instrumentation Engineering Department

SYLLABUS FOR B.TECH PROGRAMME
PART-I: COURSE STRUCTURE
**1st Year 1st Semester Syllabus:**

### Theory

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**Total Theory** 17 L 4 T 21 P 21 Credit Points

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**Total of Semester** 17 L 4 T 11 P 32 Credit Points
## 2nd Year 2nd Semester Syllabus:

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**Total of Semester**: 17 3 14 34 29
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**Total of Semester:** 12 L 2 T 15 P 29 Total 26 Credit Points

**Free Elective Papers offered by Dept. of AEIE**

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**Total of Semester** 8 1 15 24 22

**Free Elective Papers offered by Dept. of AEIE**

## Theory

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PART-II: DETAILED SYLLABUS
Course Name: Business English  
Course Code: HMTS1101  

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Module I – [5L]  
Communication Skill  
Definition, nature & attributes of Communication  
Process of Communication  
Models or Theories of Communication  
Types of Communication  
Levels or Channels of Communication  
Barriers to Communication  

Module II – [12L]  
Business Communication- Scope & Importance  
Writing Formal Business Letters  
Writing Reports  
Organizational Communication: Agenda & minutes of a meeting, notice, memo, circular  
Project Proposal  
Technical Report Writing  
Organizing e-mail messages  
E-mail etiquette  
Tips for e-mail effectiveness  

Module III – [10L]  
Language through Literature  
Modes of literary & non-literary expression  
Introduction to Fiction, (An Astrologer’s Day by R.K. Narayan and Monkey’s Paw by W.W. Jacobs), Drama (The Two Executioners by Fernando Arrabal) or (Lithuania by Rupert Brooke) & Poetry (Night of the Scorpion by Nissim Ezekiel and Palanquin Bearers by Sarojini Naidu)  

Module IV – [3L]  
Grammar in usage (nouns, verbs, adjectives, adverbs, tense, prepositions, voice change) -to be dealt with the help of the given texts.  

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**Module I [10L]**

**Thermodynamics & Spectroscopy**

*Chemical Thermodynamics & Thermochemistry*

Concept of Thermodynamic system, Introduction to first law of thermodynamics, Enthalpy Heat Capacity, Reversible and Irreversible processes, Adiabatic changes, Application of first law of thermodynamics to chemical processes, 2nd law of thermodynamics, Evaluation of entropy, Work function and free energy, Phase Changes, Clausius Clapeyron Equation, Chemical Potential, Gibbs Duhem Relation, Activity and Activity coefficient.

**Spectroscopy**

Electromagnetic Radiation, Basic idea of UV-visible & IR spectroscopy.

**Module II [10L]**

**Structure & Bonding**

*Chemical Bonding*

Covalent bond, VSEPR Theory, Molecular Orbital Theory, Hydrogen bond, Intermolecular forces-vander Waals forces, Ionization energy, Electronegativity, Electron affinity, Hybridisation, Dipole moment

*Solid State Chemistry*

Introduction to stoichiometric defects (Schottky & Frenkel) and non – stoichiometric defects (Metal excess and metal deficiency). Role of silicon and germanium in the field of semiconductor.

*Ionic Equilibria and Redox Equilibria*

Acid Base Equilibria in water, Strength of acids and bases, Hydrogen ion exponent, Ionic product of water, Salt Hydrolysis and Henderson Equation, Buffer solutions, pH indicator, Common ion Effect, Solubility product, Fractional Precipitation, Redox Equilibria,

*Structure and reactivity of Organic molecule*

Inductive effect, resonance, hyperconjugation, electromeric effect, carbocation, carbanion and free radicals.

Brief study of some addition, eliminations and substitution reactions.

**Module III [10L]**

**Electrochemistry & Reaction Dynamics**

*Conductance*

Conductance of electrolytic solutions, specific conductance, equivalent conductance, molar conductance, ion conductance, effect of temperature and concentration (Strong and Weak electrolyte). Kohlrausch’s law of independent migration of ions, transport numbers and hydration of ions. Conductometric titrations: SA vs SB & SA vs WB; precipitation titration KCl vs AgNO₃.

*Electrochemical Cell*

Cell EMF and thermodynamic derivation of the EMF of a Galvanic cell (Nernst equation), single electrode potentials, hydrogen half-cell and calomel half cell (construction, representation, cell reaction, expression of potential, discussion, application) Storage cell, fuel cell (construction, representation, cell reaction, expression of potential, discussion, application). Application of EMF measurement on a) the change in thermodynamic function (ΔG, ΔH, ΔS) b) the equilibrium constant of a reversible chemical reaction c) the valency of an ion.
**Kinetics**

Reaction laws: rate expression, order and molecularity, zero, first and second order kinetics. Pseudounimolecular reaction, Arrhenius equation.

Mechanism and theories of reaction rates (Collision theory and Transition state theory.).

Catalysis: Homogeneous catalysis (Definition, example, mechanism, kinetics).

**Module IV [10L]**

**INDUSTRIAL CHEMISTRY & POLYMERIZATION**

**Industrial Chemistry**

Solid Fuel: Coal, Classification of coal, constituents of coal, carbonization of coal (HTC and LTC), Coal analysis: Proximate and ultimate analysis.


Gaseous fuels: Natural gas, water gas, coal gas, bio gas.

**Polymerization**

Concepts, classifications and industrial applications. Polymer molecular weight (number avg, weight avg. viscosity avg.: Theory and mathematical expression only), Poly dispersity index (PDI). Polymerization processes (addition and condensation polymerization), degree of polymerization, Copolymerization, stereo-regularity of polymer, crystallinity (concept of $T_m$) and amorphicity (Concept of $T_g$) of polymer.

Preparation, structure and use of some common polymers: plastic (PE: HDPE, LDPE, PVC, Bakelite, PP), rubber (natural rubber, SBR, NBR) and Vulcanization., fibre(nylon 6.6, Nylon 6, Polyester).

Conducting and semi-conducting polymers.

**Text Books**


**Reference Books**

2. L. Finar, Organic Chemistry, Addison Wesley Longman, Inc
3. Organic Chemistry, Morrison & Boyd, Prentice Hall of India
4. Physical Chemistry, K. L. Kapoor, McMillan
Module I [10L]

**Matrix:**
Matrices and their basic attributes, Determinant of a square matrix, Minors and Cofactors, Laplace’s method of expansion of a determinant, Product of two determinants, Adjoint of a determinant, Jacobi’s theorem on adjoint determinant. Singular and non-singular matrices, Adjoint of a matrix, Inverse of a non-singular matrix and its properties, Orthogonal matrix and its properties, Special Complex Matrices: Hermitian, Unitary, Normal (definition only), Rank of a matrix and its determination using elementary row and column operations, Solution of simultaneous linear equations by : Cramer’s Rule and Matrix inversion method, Consistency and inconsistency of a system of homogeneous and inhomogeneous linear simultaneous equations, Characteristic Equation and computation of eigenvalues and eigenvectors of a square matrix (of order 2 or 3), Cayley-Hamilton theorem and its applications (with special reference to higher power of matrices, e.g. Idempotent and Nilpotent matrices)

Module II [10L]

**Mean Value Theorems & Expansion of Functions:**
Rolle’s theorem: its geometrical interpretation and its application, Concavity and Convexity of curves, Mean Value theorems – Lagrange & Cauchy and their application, Taylor’s theorem with Lagrange’s and Cauchy’s form of remainders and its application, Expansions of functions by Taylor’s and Maclaurin’s theorem, Maclaurin’s infinite series expansion of the functions: $\sin x, \cos x, e^x, \log(1 + x), (a + x)^n, n$ being an integer or a fraction (assuming that the remainder $R_n \to 0$ as $n \to \infty$ in each case).

**Infinite Series:**
Preliminary ideas of sequence, Infinite series and their convergence/divergence, Infinite series of positive terms, Tests for convergence: Comparison test, Cauchy’s Root test, D’ Alembert’s Ratio test (statements and related problems on these tests), Raabe’s test, Proof of $e$ being irrational, Alternating series, Leibnitz’s Test (statement, definition) illustrated by simple examples, Absolute convergence and Conditional convergence,

Module III [10L]

**Successive differentiation:**
Higher order derivatives of a function of single variable, Leibnitz’s theorem (statement only and its application, problems of the type of recurrence relations in derivatives of different orders and also to find $(y^n)_n$).

**Calculus of Functions of Several Variables:**
Recapitulation of some basic ideas of limit and continuity of functions of single variable, 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, Chain rules, Differentiation of implicit functions, Total differentials and their related problems, Jacobians up to three variables and related problems, Maxima, minima and saddle points of functions and related problems.

Module-IV [10L]

**Multiple Integration and Vector Calculus:**
Concept of line integrals, Double and triple integrals. 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, Green’s theorem, Gauss Divergence Theorem and Stoke’s theorem (Statements and applications).

**Reduction formula:**
Reduction formulae both for indefinite and definite integrals of types:

\[
\int \sin^n x, \int \cos^n x, \int \sin^m x \cos^n x, \int \cos^m x \sin^n x, \int \frac{dx}{(x^a + a^b)^n}, m, n \text{ are positive integers.}
\]

**References**

1. Advanced Engineering Mathematics: Erwin Kreyszig by Wiley India
2. Engineering Mathematics: B.S. Grewal (S. Chand & Co.)
3. Higher Engineering Mathematics: John Bird (Elsevier)
8. Linear Algebra (Schaum’s outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)
10. Introduction to Real Analysis: S.K. Mapa (Sarat Book Distributors)
Module-I: [12 L]

**DC Network Theorem:** Kirchhoff’s law, nodal analysis, mesh analysis, Superposition theorem, Thevenin’s theorem, Norton theorem, Maximum power transfer theorem, star-delta conversion.

**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-II [8L]

**Electrostatics:** Gauss’s law and its applications to electric field and potential calculation. Capacitor, capacitance of parallel plate capacitor, spherical capacitor and cylindrical capacitor.

**Electromagnetism:** Amperes law, Biot-savart’s law, Ampere’s circuital law and their applications, Magnetic circuits, analogy between magnetic and electric circuits, Faraday’s law, self and mutual inductance. Energy stored in a magnetic field, Hysteresis and Eddy current losses.

Module-III [10L]

**AC single phase system:** concept of alternating signal, average and RMS values of alternating signal, peak factor, form factor, phase and phase difference, phasor representation of alternating quantities, phasor diagram, AC series, parallel and series parallel circuits, Active power, Reactive power, power factor, Resonance in RLC series and parallel circuit, Q factor, bandwidth.

**Three phase system:** balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams. Power measurement by two wattmeter method.

Module-IV [10L]

**Single phase 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.

**3-phase induction motor:** Concept of rotating magnetic field, principle of operation, Construction, equivalent circuit and phasor diagram, torque-speed/slip characteristics, Starting of Induction Motor.

**Text Books:**
2. Basic Electrical Engineering, V.N Mittle & Arvind Mittal, TMH, Second Edition
3. Basic Electrical Engineering, Hughes

**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
Module-I [10L]

Importance of Mechanics in Engineering; Definition of Mechanics; Concepts of particles & rigid bodies;

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.

Definition of force vector; Dot product, cross product and the application; Important vector quantities (position vector, displacement vector); 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.

Module-II [10L]

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.

Concept of friction: Laws of Coulomb’s friction; Angle of friction, angle of repose, coefficient of friction -- static and kinematic.

Module-III [12L]

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; Parallel axes theorem.

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, elastic limit, yield point, ultimate stress, breaking point; Modulus of elasticity.

Module-IV [16L]

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

References:
1. Engineering Mechanics:- Statics and Dynamics by Meriam & Kreige, Wiley India
2. Engineering Mechanics:- Statics and Dynamics by I.H. Shames, PHI
3. Engineering Mechanics by Timoshenko, Young and Rao, TMH
4. Element of Strength of Materials by Timoshenko & Young, EWP
Course Name: Chemistry I Lab

Course Code: CHEM1011

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List of Experiments:

1. To determine the alkalinity in a given water sample.
2. Estimation of iron using KMnO₄: self indicator.
3. Estimation of iron using K₂Cr₂O₇: redox sensitive indicator.
4. To determine total hardness and amount of calcium and magnesium separately in a given water sample.
5. To determine the value of the rate constant for the hydrolysis of ethyl acetate catalyzed by hydrochloric acid.
6. Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).
7. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.
8. pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
10. To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution)
Course Name: Basic Electrical Engineering Lab

Course Code: ELEC1011

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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.
**Course Name :** Engineering Drawing  
**Course Code:** MECH1012

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**List of Experiments:**
1. Importance of engineering drawing; Acquaintance with different drafting equipment & accessories;
2. Introduction to lines: Practising different types of lines; Basic concepts in Lettering: Practising vertical & inclined letters (Practice Sheet 1)
3. Different systems of dimensioning with practice. Introduction to the concept of scale of drawing. (Practice Sheet 2)
4. Introduction to concept of orthographic projection: 1st angle and 3rd angle projection method; Symbols; projection of points. (Practice Sheet 3)
5. Projection of straight lines for different orientation including inclined to both the planes. (Practice Sheet 4)
6. Projection of plane surfaces inclined to HP and parallel to VP; Inclined to VP and Parallel to HP (Practice Sheet 5)
7. Projection of solids: Cube, rectangular prism, Hexagonal prism, Cylinder, Pyramid, Cone. (Practice Sheet 6)
8. Section of solids and their projections on principal and auxiliary planes for true shape: Cylinder, hexagonal pyramid. (Practice Sheet 7)
9. Isometric projections: Basic concepts, isometric scale; Isometric projection and view. (Practice Sheet 7)
10. Practice with simple laminar and solid objects. (Practice Sheet 7)

**References:**
1. “Elementary Engineering Drawing” by Bhatt, N.D; Charotan Book Stall, Anand
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**Module I [3P]**

*Introduction to Linguistics ( Phonology)*
- Phonetics- Vowel and Consonant Sounds (Identification & articulation)
- Word-stress
- Intonation (Falling and rising tone)
- Voice Modulation
- Accent training

**Module II [3P]**

*Listening Skills*
- Principles of Listening
- Approaches to listening
- Guidelines for Effective Listening
- Listening Comprehension
- Audio Visual (Reviews)

**Module III [2P]**

*Discourse Analysis-*
- Spoken Discourse
- Conversational Skills/Spoken Skills
- Analysing Speech dynamics
  - (Political Speeches
  - Formal Business Speeches)

**Module IV [9P]**

*Writing Skill-*
- Descriptive, narrative and expository writing
- Writing with a purpose---Convincing skill, argumentative skill/negotiating Skill (These skills will be repeated in oral skills).
- Writing reports/essays/articles—logical organization of thoughts
- Book review

**References**

Course Name: Co-curricular Activities
Course Code: HMTS1121

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Objective: This course aims at instilling a sense of social responsibility. This objective can be achieved by bringing in awareness about the contemporary issues relevant to the GenX and Gen Y through enlightened discussions and active participation. Since the course has 1 credit detailed planning regarding the area of activities and method of evaluation should be charted at the start of the semester.

Module I:

Project Work
Development of projects based on integral and holistic developmental models to be implemented in rural areas or underdeveloped areas in the peripheral areas of cities. This could include a wide area of activity – from taking up a research projects to analyse the need of a particular under-developed area to trying to implement a project already formulated. This could also relate to mobilizing funds for a specific project.

Module II:

Action-oriented schemes
e.g. Organising Blood donation camps
Conducting child healthcare services
Helping the old and sick
(in coordination with NGOs and other institutes)

Module III:

Society and Youth
Developing Awareness among the youth about social issues both local and global for e.g. Eradication of social evils like drug abuse, violence against women and others.

Module IV:

Youth and Culture
Generating new ideas and help the participants to be creative and innovative for e.g. Enacting street plays, encouraging creative writing by organizing workshops and competitions. Active participation of the students in the nation building process by making positive changes in the social and individual space.
Course Name: Introduction to Computing

Course Code: CSEN1201

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Learning Objective: Introduction to the concept of computer and computation and solving of problems using C as a programming language. Coverage of C will include basic concepts, arithmetic and logic, flow control, and data handling using arrays, structures, pointers and files.

Module I: [13L]

Fundamentals of Computer


Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Assembly language, high level language, compiler and assembler (basic concepts).

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). Binary Arithmetic & logic gates. Boolean algebra – expression, simplification, Karnaugh Maps.

Basic concepts of operating systems like MS WINDOW, LINUX. How to write algorithms & draw flow charts.

Module II: [5L]

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.

Module III: [8L]

Program Structures in C

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

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.

Module IV: [14L]

Data Handling in C

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.

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();

**Text Books**

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

**Reference Books**

1. C: The Complete Reference – Herbert Schildt
2. The C Programming Language- D.M.Ritchie, B.W. Kernighan
Module I: [22 L]

Optics
1. Interference:
The principle of superposition of waves, Superposition of waves: Two beam superposition, Multiple-beam superposition, coherent and incoherent superposition. Two source interference pattern (Young’s double slit), Intensity distribution. Interference in thin films, wedge shaped films and Newton’s rings, applications of interference. Newton’s rings: Determination of wavelength of light, refractive index of liquid.

2 Diffraction:
Diffraction of light waves at some simple obstacles. Fraunhoffer diffraction through double slit and diffraction grating, grating spectra, resolving power of grating.

3. Polarisation & Fibre Optics:
Elementary features of polarization of light waves. Production and analysis of linearly, elliptic and Circularly polarized light, polaroids and application of polarizations. fibre optics - principle of operation, numerical aperture, acceptance angle

4 Laser

Module II: [8L]

Waves & Oscillation

Module III: [9L]

Quantum Mechanics

Module IV: [6L]

Introduction of Crystallography

Text Books
1. Atomic Physics Vol 1 – S.N. Ghoshal
2. Optics – Ajoy Ghak
3. Waves & Oscillation – N.K. Bajaj

**Reference Books**

1. Introduction to Special Relativity – Robert Resnick
2. Perspective on Modern Physics - Arthur Beiser
3. Optics – Jenkins and White
5. Introduction to modern Physics – Mani and Meheta
6. Optics – Brijlal and Subrahmanyam
Module I [10 L]

Ordinary differential equations (ODE)-
First order and first degree: Exact equations, Necessary and sufficient condition of exactness of a first order and first degree ODE (statement only), Rules for finding Integrating factors, Linear and non-linear differential equation, Bernoulli’s equation. General solution of ODE of first order and higher degree (different forms with special reference to Clairaut’s equation).

Second order and first degree:

Module II:[10L]

Basics of Graph Theory
Graphs, Digraphs, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Subgraph; Walks, Paths, Circuits, Euler Graph, Cut sets and cut vertices, Matrix representation of a graph, Adjacency and incidence matrices of a graph, Graph isomorphism, Bipartite graph.

Tree:
Definition and properties, Binary tree, Spanning tree of a graph, Minimal spanning tree, properties of trees, Algorithms: Dijkstra’s Algorithm for shortest path problem, Determination of minimal spanning tree using DFS, BFS, Kruskal’s and Prim’s algorithms.

Module III [10L]

Improper Integral:
Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations.

Laplace Transform:
Introduction to integral transformation, functions of exponential order, Definition and existence of 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.

Module IV [10L]

Three Dimensional Geometry
Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Shortest distance between two lines. Condition of coplanarity of two lines. Length of the perpendicular from a point to a given line.

References:
2. Graph Theory: V. K. Balakrishnan, (Schaum’s Outline, TMH)
3. A first course at Graph Theory: J. Clark and D. A. Holton (Allied Publishers LTD)
4. Introduction to Graph Theory: D. B. West (Prentice-Hall of India)
5. Graph Theory: N. Deo (Prentice-Hall of India)
10. Introductory Course in Differential Equations: Daniel A. Murray (Longmans & Green).
12. Analytical Geometry And Vector Algebra- R M Khan
Course Name: Basic Electronics Engineering

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**Module I [10 L]**

**Semiconductors:**
Crystalline material, Energy band theory, Fermi levels; Conductors, Semiconductors and Insulators: electrical properties, band diagrams. Semiconductors: intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers.

**Diodes and Diode Circuits:**
Formation of P-N junction, energy band diagram, built-in-potential forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener Diode and its Application, Zener and Avalanche breakdown.
Simple diode circuits, load line, piecewise linear model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

**Module II [10 L]**

**Bipolar Junction Transistors:**
Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off, active and saturation modes of operation, transistor action, input & output characteristics, load line & amplifier operation and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor.

**Module III [9 L]**

**Field Effect Transistors:**
Junction field effect transistor (JEET): Principle of operation, JFET parameters, eqv. Circuit, JFET biasing, self bias, design of bias circuits, load line, amplifier characteristics.

**MOSFETs:**
Construction & principle of operation of p- & n-channel enhancement & depletion mode MOSFETs, drain & transfer characteristics, threshold voltage & its control.

**Cathode Ray Osilloscope:**
Construction and working principle of CRO, Lissajous pattern.

**Module IV [9 L]**

**Feed Back Amplifier:**
Concept-block diagram, properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, condition of oscillation, Barkhausen criteria.

**Operational Amplifier:**
Introduction to integrated circuits, operational amplifier and its terminal properties; Application of operational amplifier; Concept of op-amp saturation, inverting and non-inverting mode of operation, Adders, Subtractors, Voltage follower, Integrator, Differentiator, Basic Comparator Circuit.

**References:**
2. R.A Gayakwad: Op Amps and Linear IC’s, PHI
4. Adel S. Sedra, Kenneth Carless Smith: Microelectronics Engineering
Module I [10 L]

Basic concepts of Thermodynamics:
Introduction; Macroscopic and microscopic concept; Definition of Thermodynamic systems; Surrounding, universe; Open, closed and isolated systems; Concept of control volume; Thermodynamic properties: intensive, extensive & specific properties; state. Thermodynamic equilibrium; Change of state; Thermodynamic processes and cycles; Quasi-static processes; Reversible processes; Zeroth law of Thermodynamics - concept of temperature.

Heat & Work:
Definition 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; Indicated diagram (P-V diagram).
Definition of heat; Heat transfer—a path function; Similarities and dissimilarities between heat and work.

Module II [8 L]

First law of Thermodynamics: Statement; 1st law 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; Flow work; 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, boiler, condenser and throttling device); PMM-I

Module III [10 L]

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.
Reversible process; Irreversible process; Factors for irreversibility; Carnot cycle and Carnot efficiency; Reversible heat engine and heat pump; PMM-II
Entropy: Mathematical statement of Clausius Inequality: Entropy as a property; Entropy principle; T-s plot for reversible isothermal, adiabatic, isochoric & isobaric processes.

Air standard Cycles:
Otto cycle & Diesel cycle, P-V & T-s plots, Net work done and thermal efficiency.

Module IV [10 L]

Properties & Classification of Fluid:
Definition of fluid; Concept of Continuum; Fluid properties- density, specific weight, specific volume, specific gravity; Viscosity: definition, causes of viscosity, Newton’s law of viscosity, dimensional formula and units of viscosity, kinematic viscosity; Variation of viscosity with temperature. Ideal and Real fluids; Newtonian and Non-Newtonian fluids;
No-slip condition.
Compressibility and Bulk modulus of elasticity.
Difference between compressible and incompressible fluids.

**Fluid Statics:**
Introduction; 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.
Characteristics and choice of manometric fluid.

**Module V [10 L]**

**Fluid Kinematics:**
Definition; Flow field and description of fluid motion(Eulerian & Lagrangian method), steady and unsteady flow, uniform and non-uniform flow-examples.
Acceleration of a fluid particle-local acceleration, convective acceleration. Stream line, Stream tube, Path line and Streak line; Laminar and Turbulent flow, Reynolds Number. Equations of streamlines and path lines.
Continuity equation for unidirectional flow and for differential form in 3-D Cartesian coordinate system.

**Dynamics of Ideal fluids:**
Introduction, Euler’s equation of motion along a streamline; Bernoulli’s equation-assumptions and significance of each term of Bernoulli’s equation. Application of Bernoulli’s equation-problem on pipe line. Measurement of flow rate: Venturimeter and orificemeter.
Static pressure, Dynamic pressure, Stagnation pressure-measurement of velocity by Pitot tube.

**References:**
1. Engineering Thermodynamics- Nag, P.K. - T. M.H
2. Fundamentals of Thermodynamics- Sonntag, Borgnakke & Van Wylen, Wiley India
3. Thermodynamics- an Engineering approach - 6e, Cengel & Boles, TM
Course Name: Introduction to Computing Lab  
Course Code: CSEN1211  

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Basic Computation & Principles of Computer Programming Lab

Softwares to be used: Cygwin and notepad++, Tiny C

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

1. Determination of Young’s modulus by Flexure Method and calculation of bending moment and shear force at a point on the beam.
3. Determination of thermal conductivity of a good conductor by Searle’s Method.
4. Determination of thermal conductivity of a bad conductor by Lee’s and Chorlton’s Method.
5. Determination of dielectric constant of a given dielectric material.
6. Use of Carey Foster’s bridge to determine unknown resistance.
8. Determination of wavelength of light by Fresnel’s biprism method.
10. Determination of dispersive power of the material of a given prism.
11. Determination of co-efficient of viscosity of a liquid by Poiseulle’s capillary flow method.
Course Name: Basic Electronics Engineering Lab

Course Code: ECEN1011

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**List of Experiments:**

1. Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc.
2. Familiarisation 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
Course Name : Workshop Practice
Course Code: MECH1011

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Job 1: General awareness of a typical workshop.

Theory requirements: Workshop definition, various shops in a typical workshop, Carpentry, Fitting, Foundry; Sheet Metal Shop, Welding and Brazing Shop, Machine Shop, Forging & Blacksmithy, Safety precautions to be followed in a workshop, Familiarization of Various safety devices and their uses.

Job 2: Making of a wooden pattern.


Job 3: Making of a matched profile form MS plate.

Theory requirements: Work Bench, Fitting Tools (Bench Vice, Chisel, Hammer), Different types of Files, (Rough, Bastard, Second Cut, Half Round, Triangular File), Saw (Hack saw etc.), Scriber, Punch, Try Square, Angle Plate, caliper (outside & inside), Universal Surface Gauge, Centre Punch, Prick Punch, Drill (Flat, straight fluted, taper shank twist drill). Fitting Operations, Filing, Marking, Drilling, Tapping (Rougher, Intermediate, Finisher taps), Tap Drill size (D=T-2d), Sawing, Dieing. Safety precautions in Fitting Shop.

Job 4: Making of an internal and external thread.


Job 5: Making of a green sand mould using the pattern made under Job no. 2.

Theory requirements: Mould making, Preparation of sand, (silica, clay, moisture, and misc items and their functions), Properties of a good sand mould, General procedure for making a good sand mould, Different tools used for preparation of a mould, Explanation of various terms, Cope and Drag Box, Runner, Riser, Gating and its utility, Parting sand, Vent holes.

Job 6: Demonstration of metal melting and casting

Theory requirements: Metal melting furnaces: Ladles, Using of Tongs, Molten metal pouring procedure, Safety precautions in pouring molten metal in a mould.

Job 7: Making of a stepped pin in a centre lathe. (2 Classes)

Theory requirements: Machining and common machining operations, Lathe M/c and its specifications, Head stock, Tailstock, Chuck-Self centering chuck, 4 jaw chuck, Bed, Carriage, Feed mechanism, Screw cutting mechanism, various lathe operations like turning, facing, grooving, chamfering, taper turning, Thread cutting, Knurling, Parting, Cutting speed, Feed, Depth of cut, Different types of cutting tools-Safety precautions in a machine shop.

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Job 8: Making of square prism from a round shaft by Shaping Machine

Theory requirements: Description of a Shaping machine, Base, Column, Saddle, Clapper box, Quick return mechanism, Feed Mechanism, Table, Rotation of table, Adjustment of stroke length, Adjustment of starting point of cut. Safety Precautions while working in Shaping Machine.

Job 9: Making of square prism from a round shaft by Milling Machine


Job 10: Arc Welding practice and making of a welded joint

Theory requirements: Welding, Weldability, Types of Welding, MMAW, Gas Welding, Electrode, Functions of Flux, Equipment for MMAW, Different types of Flames in Gas Welding and Gas Cutting (Neutral-Oxidising-Reducing Flames), Different types of welding joints, AC Welding, DC Welding; Safety precautions in Welding Shop.

Job 11: Sheet Metal forming & Brazing


References:
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, 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, 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:**
Course Name: Mathematical Methods
Course Code: MATH2001

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Module I:

Functions of Complex Variables (12L)
Complex numbers and its geometrical representation.
Functions of a complex variable – Limits, Continuity, 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:

Fourier Series, Integrals and Transforms (12L)
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.

Module III:

Series solutions to Ordinary Differential equations and Special Functions (12L)
Series solution of ODE: Ordinary point, Singular point and Regular Singular point, series solution when is an ordinary point, Frobenius method.
Legendre’s Equation, Legendre’s polynomials 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.

Module IV:

Partial Differential Equations (12L)
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.

References:

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

Course Outcome:

After the completion of the course student will be able to

1. Synthesize components of a physical phenomenon and consequently construct a mathematical model of the system.
2. Classify engineering problems like forced oscillations, RLC Circuits etc.
3. Apply suitable analytic methods to solve wave equations, heat conduction equation.
4. Evaluate the efficiency of a method to solve ordinary and partial differential equations.
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Module I:

**Numerical solution to linear and non-linear equations (8L)**

Solution of non-linear algebraic equations and transcendental equations:
Bisection Method, Newton-Raphson Method, Regula-Falsi Method.

**Solution of linear system of equations:**
Gaussian elimination method, Gauss-Seidel Method, LU Factorization Method.

Module II:

**Numerical solution to integration and ordinary differential equations (8L)**

**Interpolation and integration:**
Newton’s Forward and Backward Interpolation Method, Lagrange’s Interpolation, Trapezoidal and Simpson’s 1/3rd Rule.

**Solution of ordinary differential equations:**
Euler’s and Modified Euler’s Method, Runge-Kutta Method of 4th order.

Module III:

**Fundamentals of probability (5L)**

Prerequisites- Set Theory.
Random experiment, Sample space, Events.
Definition of Probability,
Addition law of probability, Multiplication law and Conditional Probability.
Bayes’ Theorem (Statement only)

Module IV:

**Probability distributions and statistics (15L)**


Simple Correlation and Regression.

**References:**
5. A First course in Probability, Sheldon Ross, Pearson

**Course Outcomes:**

After the completion of the course students will be able to
1. Apply numerical methods to obtain approximate solutions to mathematical problems where analytic solutions are not possible.
2. Develop algorithmic solutions for problems like system of linear equations, integration, ordinary differential equations which are pertinent to many physical and engineering problems.
3. Apply probabilistic methods to engineering problems where deterministic solutions are not possible.
4. Analyze probability distributions required to quantify phenomenon whose true value is uncertain.
5. Find numerical solutions to algebraic and transcendental equations appearing in a vast range of engineering problems e.g in the study of Ideal and non ideal gas laws, pipe friction, design of electric circuits.
6. Apply numerical methods to find solutions to linear system of equations appearing in spring-mass systems, resistor circuits, steady state analysis of a system of reactors.
7. Solve problems in data analysis, least-cast treatment of wastewater where the knowledge of interpolation will be required.
8. Compute numerical solution to integrals to find root mean square current.
Course Name: Data Structure and Basic Algorithms
Course Code: CSEN2001

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Pre-requisites:
Introduction to Computing, Mathematics, Set theory

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 (7L)
Stack and Queue (5L):
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 (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 (12L)
Sorting Algorithms (7L):
Bubble sort, insertion sort, shell sort, selection sort, merge sort, quicksort, heap sort, radix sort.
Searching (2L):
Sequential search, binary search, Interpolation Search
Hashing (3L):
Hashing functions, collision resolution techniques (Open and closed hashing).
References:
2. “Fundamentals of Data Structures of C” by Ellis Horowitz, Sartaj Sahni, Susan Anderson-
   freed.
   Rivest, Clifford Stein.

Course Outcomes:
After the completion of the course, the students are expected to be:
Capable of understanding the data structures, their advantages and drawbacks, how to
implement them in C (or in any other programming language), how to overcome their
drawbacks, what their applications are and where they can be used. Students should be able to
learn about the data structures/ methods/ algorithms mentioned in the course with a comparative
perspective so as to make use of the most appropriate data structure/ method/algorithm in a
program to enhance the efficiency (i.e. reduce the running time) or for better memory utilization,
based on the priority of the implementation. It is expected that the students will be able to
understand the efficiency aspects of the graph and sorting algorithms covered in this course. The
students should be able to convert an inefficient program into an efficient one using the
knowledge gathered from this course.
Course Name: Analog Electronics
Course Code: AEIE2101

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Module I - [6L]

Diode and Diode circuits: Diode characteristics and Peak Inverse Voltage, Analysis of Ideal and Practical diode circuits, Rectifier circuits (half wave and full wave rectifier circuits), Bridge rectifier circuit, Voltage Regulator circuits, series and shunt voltage regulators, percentage regulation, Clippers and Clampers.

Module II – [16L]

Transistor Biasing, Amplifiers and Feedback Circuits: Operating-point, fixed bias, collector to emitter bias, voltage divider bias, variation of operating point and its stability, RC coupled amplifier, Effect of Emitter and coupling capacitors, Frequency Response of single-stage and multistage.

CE transistor amplifier, Transistor Hybrid model, Analysis (Voltage gain, Current gain, Input and Output Impedance, Trans-resistance & Trans-conductance) of a Transistor amplifier circuit by h-parameters, Bandwidth and concept of wide band amplifier, Principle of frequency translation, concept of heterodyne principle.

Power Amplifier (Class A, B, AB and C), Concepts of distortion in amplifier circuits, Feedback concept, Effect of positive and negative feedbacks, voltage/current, series/shunt feedback, Berkhausen criterion, Colpitts, Hartley, Phase shift, Wein bridge and crystal oscillators.

Module III-[8L]

Basics of Operational Amplifier: Basics of OPAMP, Differential (ac and dc analysis) and Common mode operation, Constant current source, level shifter, Open & Closed loop circuits, importance of feedback loop (positive & negative), inverting & non-inverting amplifiers, voltage follower/buffer circuit, Adder, Subtractor, Integrator & differentiator, Multiplier, Divider, comparator.

Module IV-[10L]


References:

1. Sedra & Smith-Microelectronic Circuits- Oxford UP
4. Coughlin and Driscoll – Operational Amplifier and Linear Integrated Circuits – Pearson Education
11. Bell- *Operational Amplifiers and Linear ICs*- Oxford UP

**Course Outcomes:**

After completing the course the students will be able to

1. Understand the methods to determine the operating point of a transistor amplifier in the active region of the characteristics and to manipulate the operating point due to the variation of temperature and will be capable to analyze different kind of regulators.
2. Analyze different amplifier circuits and to identify different types of feedback methods. Students will also be able to compare between different types of Oscillators.
3. Learn detailed analysis of the several stages in a bipolar transistor Op-amp. They will also learn the methods to calculate Op-amp parameters and will be able to use Op-amp in practical applications.
Course Name: Circuit Theory and Networks
Course Code: AEIE2102

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Module I – [17L]
Analysis of DC & AC circuits: Analysis of circuits with and without controlled sources using mesh, node analysis, Superposition, Thevenin’s, Norton’s, Millman’s, and Maximum Power Transfer Theorem.
Analysis of coupled circuits: Self and mutual inductances, coefficient of coupling, dot convention, equivalent circuit, solution using loop analysis.
Series and parallel resonance circuits: Condition of resonance, impedance curve, current curve, half power points, bandwidth, quality factor, selectivity, application to different combination of parallel circuits.

Module II – [8L]
Time domain analysis of R-L and R-C circuits: Forced and natural response, time constant, initial and final values.
Solution using first order equation for standard input signals: Transient and steady state time response, solution using universal formula.
Time domain analysis of R-L-C circuits: Forced and natural response, effect of damping.
Solution using second order equation for standard input signals: Transient and steady state time response.
Frequency domain analysis of RLC circuits: S-domain representation, applications of Laplace Transform in solving electrical networks, driving point and transfer function.

Module III – [9L]
Two Port Network: open circuit, short circuit, transmission and hybrid parameters, relationships among parameters, reciprocity and symmetry conditions.
Graph Theory: Concept of graph, tree, branches, twigs, links, incidence matrix, reduced incidence matrix, tie-set matrix, cut-set matrix.

Module IV – [6L]
Basic filter circuit Design & Synthesis: Low pass, high pass, band pass and band reject filters, transfer function, frequency response, cutoff frequency, bandwidth, quality factor, attenuation constant, phase shift, Butterworth filter 2nd, 3rd and 4th order design (RC).

References:
**Course outcome:**

After completing the course the students will be able to

1. Evaluate electrical variables in DC & AC networks with independent and/or dependent sources.
3. Examine the amplifiers and various parameters related to electrical transmission lines.
4. Design any filter circuits.
Course Name: Numerical and Statistical Methods Lab
Course Code: MATH2012

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Development of computer programs in C for the following problems:

1. Regula-Falsi Method
2. Newton-Raphson Method
3. Gauss-elimination Method
4. Gauss-Seidel Method
5. Newton’s Forward Interpolation
6. Lagrange’s Interpolation
7. Trapezoidal and Simpson’s 1/3rd rule
8. Euler’s and Modified Euler’s Method
9. Runge-Kutta method of 4th order
10. Computation of Mean, Median, Mode and Standard Deviation for grouped and ungrouped frequency distribution
11. Computation of Correlation coefficient and Regression equation for Bivariate data.

Course outcome:

After completing the course the student will be able to:

1. Reproduce customized programs to solve problems based on Numerical Methods. Develop algorithms to handle large systems of equations appearing in physical and engineering problems.
Course Name: Data Structure and Basic Algorithms Lab
Course Code: CSEN2011

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**List of Experiments:**

1. Implementation of array operations.
2. Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements
   Merging Problem.
3. Evaluation of expressions operations on Multiple stacks & queues.
4. Implementation of linked lists: inserting, deleting, inverting a linked list.
5. Implementation of stacks & queues using linked lists:
6. Polynomial addition, Polynomial multiplication.
7. Sparse Matrices : Multiplication, addition.
8. Recursive and Nonrecursive traversal of Trees.
9. Threaded binary tree traversal.
10. DFS and BFS.
11. Application of sorting and searching algorithms.
Course Name: Analog Electronics Lab
Course Code: AE1E2111

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List of Experiments:
1. Introduction: Study of characteristics curves of B.J.T.
2. Study the effect of different parameters on frequency response of a two-stage R-C coupled amplifier and verify phase difference between input and output voltage.
3. Study of Integrator and Differentiator circuits with different types of input waveforms.
9. Realization of a Phase Locked Loop using Voltage Controlled Oscillator (VCO).
10. Design of an Oscillator circuit (Phase shift/ Wien Bridge).

Course Outcome:
Students will be able to
1. Analyze the different components of electronic circuits appropriately
2. Analyze the different electronic circuits
3. Design different kind of electronic circuits appropriately to obtain the best possible circuits that can be applied to any electronic systems
Course Name: Circuits and Networks Lab

Course Code: AEIE2112

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A. Hardware Based Experiment:
1. Verification of Thevenin’s and Norton’s theorem.
3. Frequency response of Passive and active (LP, HP, BP, BR) filters of 1st & 2nd order

B. Software Based Experiment
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 applying different inputs
   iv. Frequency response of 2nd order system
2. MATLAB Based:
   i. Different types of signal generation
   ii. Laplace and inverse Laplace transform

Course outcome:
After completing the course the students will be able to
1. Apply analysis tools, theorems to analyze the experimental result.
2. Analyze RL, RC, RLC circuits in time domain & frequency domain.
3. Carry out time & frequency domain measurements on elementary RL, RC, RLC circuits using simulation software.
Course Name: Indian Culture and Heritage
Course Code: HMTS2002

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Module I

Indian Religion & Philosophy
1. Orthodox Indian Philosophy:
2. Unorthodox Indian philosophy:
3. Essentials of Hinduism
4. An overview of Jainism, Buddhism, Sikhism, Islam, Christianity religions

Module II

Values and Personality
1. Aspects of Indian Values
2. Essentials of Personality Building
3. Ethics at work place
4. Aspects of Leadership qualities

Module III

Indian Scriptures
1. Selections from the Vedas
2. Select verses from Upanishad
3. An overview of Gita
4. XVIth chapter of Gita

Module IV

Indian Psychology
1. Aspects of Yoga Philosophy
2. Mind and its workings according to Yoga
3. Law of Karma
4. Selections from Manusmriti

References:
1. Indian Philosophy by S.C. Chatter and D. M. Dutta, Calcutta University Press
2. Spiritual Heritage of India, Swami Prabhavananda, Sri Ramakrishna Math, Chennai
3. Raja Yoga by Swami Vivekananda, Advaita Ashrama, Mayavati
4. Vedic Selection, Calcutta University Press
5. Gita by Swami Swarupananda, Advaita Ashrama, Kolkata
6. Upanishads by any press
7. Carving a Sky (MSS) by Samarpan
8. Essentials of Hinduism (MSS) by Samarpan
9. The Call of the Vedas — Bharatiya Vidya Bhavan
Module I

**Environment & Ecology (General discussion) (9L)**

Basic ideas of environment and its component  
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.  
General idea of ecology, ecosystem – components, types and function.  
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.  
Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphorus, Sulphur].  
Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.

Module II

**Air pollution and control (9L)**

Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause.  
Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Acid rain: causes, effects and control. Earth’s heat budget, carbon capture, carbon footprint  
Lapse rate: Ambient lapse rate, adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion, Maximum mixing depth  
Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN.  
Smog: Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification  
Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).

Module 3

**Water Pollution and Control (9L)**

Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides  
River/Lake/ground water pollution: River: DO, 5 day BOD test, Unseeded and Seeded BOD test, BOD reaction rate constants, COD.  
Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)  
Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening]
Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] 2L
Water pollution due to the toxic chemicals effects: Lead, Mercury, Cadmium, Arsenic. 1L

**Noise Pollution**
Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise]. Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, $L_{10}$ (18hr Index), effective perceived noise level.
Noise pollution control. 2L

**Module 4**

**Land Pollution (9L)**
Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes, electronic waste 2L
Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. 2L

**Social Issues, Health and Environment**
Environmental disasters: Bhopal gas tragedy, Chernobyl disaster, Three Mile Island disaster, cancer and environment: carcinogens, teratogens and mutagens (general aspect) 2L
Environmental impact assessment, Environmental audit, Environmental laws and protection act of India. 1L
Energy audit, Green building, Green sources of energy, Concept of Green Chemistry, Green catalyst, Green solvents (replacement of VOC) 2L

**References**
3. Asim K. Das, Environmental Chemistry with Green Chemistry, Books and Allied P. Ltd
4. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd
5. GourKrishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology, Vikas Publishing House P. Ltd.

**Course Outcomes:**
After completing the course, the students will be able to:

1. Understand importance of protection and conservation of our indiscriminate release of pollution (air, water, land and noise) into the environment. It is incumbent upon us to save the humanity from extinction. Consequent to our activities, constricting the environment and depleting the biosphere, in the name of development.
2. Learn the methods to determine the operating point of a transistor amplifier in the active region of the characteristics and to manipulate the operating point due to the variation of temperature. Students will be able to analyze different kind of regulators.
3. Recognize and appreciate the significant role of biodiversity in sustaining life on our planet and articulate the role and relevance of environmental science in society.
4. Demonstrate a broad knowledge in ecology and conservation biology and geographical science and an understanding of the multi-disciplinary and inter-disciplinary nature of environmental science.
Course Name: Physics II
Course Code: PHYS2001

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Module I:

**Lagrange and Hamiltonian (4L)**
Generalised coordinates, constrains, Lagrange’s Equation of motion and Lagrangian, generalised force potential, momenta and energy. Hamiltonian formulation, Hamilton’s Equation of motion. Course should be discussed along with physical problems of 1-D motion

**Quantum Mechanics (6L)**
Concept of probability and probability density, operator, Commutator, Formulation of quantum mechanics and Basic postulates, Operator correspondence, Time dependent Schrödinger’s equation, formulation of time independent Schrödinger’s equation by method of separation of variables, Physical interpretation of wave function $\Psi$(normalization and probability interpretation), Expectation values, Application of Schrödinger equation-Particle in an infinite square well potential (1-D and 3-D potential well), Discussion on degenerate levels.

Module II:

**Statistical Mechanics (6L)**
Concept of energy levels and energy states. Microstates, Macrostates and thermodynamic probability, equilibrium macrostate. MB, FD, BE statistics (no deduction necessary), fermions, bosons (definitions in terms of spin, examples), physical significance and application, classical limits of quantum statistics. Fermi distribution at zero and non–zero temperature.

**Applications of Statistical Mechanics (4L)**
Planck’s Black body radiation, Fermi Level in Intrinsic and Extrinsic Semiconductors, Intrinsic Semiconductors and Carrier Concentration, Extrinsic Semiconductors and Carrier Concentration, Equation of Continuity, Direct & Indirect Band Gap Semiconductors

Module III:

**Dielectric Properties (5L)**

**Magnetic Properties (5L)**

Module IV:

**Band Theory of Solids (6L)**

**Super Conductivity (4L)**
Recommended Text Book:

**Quantum Physics**
- Atomic Physics – S.N. Ghoshal – S Chand
- Quantum Physics– Eisberg and Resnick – Wiley
- Quantum Mechanics – A.K. Ghatak and S. Lokenathan –Springer

**Classical Mechanics**

**Solid State Physics**
- Atomic Physics – S.N Ghoshal
- Solid State Physics – A.J Dekkar – Macmillan
- Introduction to Solid state Physics – C.Kittel

**Statistical Mechanics**
- Thermodynamics, Kinetic Theory, and Statistical Mechanics–Sears and Salinger–Narosa

**Course Outcomes:**
Students undertaking this course should develop a basic understanding of quantum mechanics with thorough knowledge of operator functions and solution and applications of Schrodinger equation; they should acquire the concepts of basic solid state physics and classification of solids; the students must develop an idea of the different types of statistical distributions and be able to understand semiconductor behavior by application of statistical methods. They will also get a thorough understanding of different dielectric materials, physical interpretation of magnetic properties of matter, and basic understanding of superconductivity. In all cases they must build an ability of addressing related problems and explore the applications of the different theories.
Course Name: Digital Electronic Circuits
Course Code: AEIE2201

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Module I - [10L]
Data and number systems: Binary, Octal and Hexadecimal representation and their conversions, BCD, ASCII, EBDIC, 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, Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-map method and Quine-McCluskey method.

Module II - [08L]
Combinational circuits: Adder and Subtractor circuits; Applications and circuits of Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator and Checkers.

Module III - [12L]

Module IV - [10L]
A/D (Ramp-compare, Successive - approximation and Flash type) and D/A (Binary weighted and R-2R Ladder type) conversion techniques.
Introduction to Various Logic Families: TTL, ECL, MOS and CMOS, their operation and specifications.
Memories and Programmable Logic Devices: RAM, ROM, EPROM, EEROM, PLA and PAL.

References:
1. Malvino & Brown, Digital Computer Electronics, TMH
3. M. Mano, Digital Logic and Design, PHI
4. A. Anand Kumar, Fundamentals of Digital Circuits, PHI
5. Kharate, Digital Electronics, Oxford
7. S Salivahanan & S Arivazhagan, Digital Circuits and Design, Vikas Publication

Course outcome:
After the completion of the course the students will be able to:
1. Represent numerical values in various number systems and perform number conversions between different number systems.
2. Explain the operation of logic gates (AND, OR, NAND, NOR, XOR, XNOR) and apply the laws of Boolean algebra to simplify circuits and Boolean algebra expressions using K-map and Quine-McCluskey method.
3. Demonstrate the knowledge of operation of basic types of flip-flops, registers, counters, decoders, encoders, multiplexers, de-multiplexers, adder and subtractor.
4. Describe the nomenclature and technology in the area of memory devices: ROM, RAM, PROM, PLD, FPGAs, etc.
Module I – [13L]
Definition, principles of sensing and transduction, classification; concept of signal conditioning. Mechanical and Electromechanical sensors
Resistive (potentiometric) type: Forms, materials, resolution, accuracy, sensitivity
Strain Gauges: theory, types, materials, design consideration, sensitivity, gauge factor, temperature dependance, adhesives, rosettes, applications-force, velocity and torque measurements
Inductive sensors: common types- reluctance change type, mutual inductance change type, LVDT: Construction, materials, output-input relationship, discussion
Capacitive sensors: Variable distance- parallel plate type, Variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type: calculation of sensitivities; proximity measurement, Stretched Diaphragm type: microphones, response characteristics

Module II – [10L]
Magnetic sensors: Sensors based on Villari effect for assessment of force, torque, rpm meters, proximity measurement
Hall Effect and Hall drive, performance characteristics
Piezoelectric elements: piezoelectric effects, charge and voltage coefficients, crystal model, materials, natural and synthetic types – their comparison, force and stress sensing, piezoelectric accelerometer
Tachometers – Stroboscopes, Encoders, seismic accelerometer, Measurement of vibration.

Module III – [9L]
Industrial weighing systems : Link–lever mechanism, Load cells – pneumatic, piezo-electric, elastic and magneto-elastic types - their mounting, connections & circuits, pressductor, different designs of weighing systems, conveyors type, weighfeeder type.
Thermal sensors: RTD – materials, construction, types, working principle, 2-wire, 3-wire and 4-wire configuration and circuit arrangement.
Thermistor – materials, construction, types, working principle
Thermo-emf sensors: Thermocouple – Thermoelectric Laws, types, working principle, Thermopile, series and Parallel configuration of thermocouple, Wien’s displacement Law, Pyrometer (total radiation and optical types)

Module IV – [8L]
Optical Sensors: Introduction to optical fibres, LDR, Photodiode, Photovoltaic cell, Photomultiplier Tube.
Geiger counters, Scintillation detectors, Ultrasonic sensors: working principle, medical & industrial applications. Introduction to Smart sensors, Advantages of Smart sensor over conventional sensors.

References:
1. D Patranabais, Sensors and Transducers, PHI, 2nd ed.

**Course Outcomes:**

After the completion of the course students will be able to

1. Describe the characteristics 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 measurand.
4. Design the signal conditioning circuits for electromechanical sensors.
5. Justify the selection of Sensors and Transducers in the process of Measurement and instrumentation.
Module I – [10L]
Static characteristics of instruments: Accuracy, Sensitivity, Repeatability, Precision, Significant figures, Drift, Hysteresis, Threshold, Resolution, Dynamic characteristics of instruments: Fidelity, Speed of response.
Classification of analog instruments, Types of torques in indicating instruments, Ballistic galvanometer, 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.
Module II – [7L]
Instrument transformer: Current transformer & Potential Transformer
D.C. Potentiometer: Basic slide wire potentiometer, Crompton’s potentiometer,
A.C. Potentiometer: Drysdale polar potentiometer, Gall-Tinsley potentiometer; Measurement of energy by single phase induction type meter.
Module III – [11L]
Measurement of medium resistance: Ammeter-voltmeter methods, Substitution method, Wheatstone bridge method; Measurement of low resistance by Kelvin Double bridge; 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, Hay’s bridge, Anderson’s bridge; Measurement of capacitance: De Sauty’s bridge, Schering bridge, Carey Foster bridge (in terms of standard mutual inductance), Measurement of mutual inductance: Heaviside mutual inductance bridge, Heaviside Campbell bridge; Measurement of frequency by Wien’s bridge, Wagner Earthing device.
Module IV – [8L]
Localization of cable faults using Murray and Varley loop methods;
Static calibration of instruments & Curve fitting methods (sequential differences, extended differences and least squares method); Errors; Combination of limiting errors; Statistical treatment of Errors: Measures of Central Tendency and Dispersion; Error estimation from Normal Distribution, Chi-Square test; Reliability Principles: Reliability, Un-reliability, MFR, MTTF, MTBF, MDT, MTTR, Bath Tub curve.
References:
1. Golding & Widdis, Electrical Measurements & Measuring Instruments ; Wheeler
2. W. D. Cooper, Electronic Instrument & Measurement Technique; Prentice Hall of India
3. Forest K. Harris, Electrical Measurement; Willey Eastern Pvt. Ltd. Indi
4. M.B. Stout, Basic Electrical Measurement; Prentice Hall of India
5. A. K. Ghosh, Introduction to Measurements & Instrumentation, Prentice Hall, India
Course Outcome:
The students will be able to
1. Apply the knowledge about the instruments to use them more effectively.
2. Select the kind of instrument suitable for typical measurements.
3. Choose appropriate bridge for measurement of impedance.
4. Estimate & analyze the errors associated with static calibration
Course Name: Language Practice Lab (Level 2)
Course Code: HMTS2011

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Module 1

Formal verbal communication:
- Introduction to formal verbal communication, Interpersonal Skills & Public Speaking:
  Building Positive Relationships, Focusing on Solving Problems, Time Management, Dealing with Criticism: Offering Constructive Criticism, Responding to Criticism – Managing Conflict: Approaches to Conflict, Resolving Conflict
- Conversational skills in the business scenario: One-to-one and Group communication, Gender and Culture Sensitivity, Etiquette, Sample Business Conversation, Telephonic Conversation

Module II

Presentation skills
- Speech Purposes - General: Informative Speeches, Persuasive Speeches, Entertaining Speeches, Methods of Speaking: Speaking from a Manuscript, Speaking from Memory, Impromptu Delivery, Extemporaneous Delivery, Analyzing the Audience, Nonverbal Dimensions of Presentation
- Organising the Presentation: the Message Statement, Organising the Presentation: Organizing the Speech to Inform, The Conclusion, Supporting Your Ideas – Visual Aids: Designing and Presenting Visual Aids, Selecting the Right Medium, Post-presentation Discussion

Module III

Group Discussion
- Introduction to Group Communication

Module IV

Job Application and Personal Interview
- **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
Heading, Career Goal or Objectives, Education, Work Experience, Summary of Job Skills/Key Qualifications, Activities, Honours and Achievements, Personal Profile, Special Interests, References

- **Interviewing**
Course Name: Physics II Lab
Course Code: PHYS2011

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Group 1: Experiments on Electricity and Magnetism

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 2: Quantum Physics

5. Determination of Planck’s constant.
6. Determination of Stefan’s radiation constant.
7. Verification of Bohr’s atomic orbital theory through Frank-Hertz experiment.
8. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum

Group 3: Modern Physics

9. Determination of Hall co-efficient of semiconductors
10. Determination of band gap of semiconductors.
11. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

Note: A candidate is required to perform at least 5 experiments taking one from each group. Emphasis should be given on the estimation of error in the data taken.

Course Outcome:

After taking this course, which is a laboratory paper students will be able to apply theoretical knowledge of electricity and magnetism, quantum physics and semiconductor physics to perform various experiments that will help them determine some very important material constants viz. dielectric constant, Hall coefficient, band gap of semiconductors etc., as well as some universal constants of great importance like Stefan’s constant, Planck’s constant etc. They will develop skills of result analysis and graph plotting along with operational skills of the different experimental apparatus.
Course Name : Digital Electronic Circuits Lab

Course Code: AE1E2211

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List of Experiments:

Design and Implementation of:
1. Basic gates using Universal logic gates.
2. Adder/Subtractor.
3. BCD to Excess-3 and Excess-3 to BCD Code Converters.
5. Simple Decoder & Multiplexer circuits using logic gates.
6. 4-bit parity generator & comparator circuits.
7. RS, JK & D flip-flops using Universal logic gates.
10. Shift register (Right and Left) using flip-flops.
11. Ring counter.

Course outcome:

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

1. Demonstrate the knowledge of operation of basic gates using Universal logic gates.
2. Demonstrate the knowledge of operation of Adder/Subtractor, BCD to Excess-3 and Excess-3 to BCD Code Converters, Decoder & Multiplexer circuits using logic gates, 4-bit parity generator & comparator circuits.
Course Name: Electrical Measurement Lab  
Course Code: AEIE2212  

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List of Experiments:
2. Calibration of moving iron and electrodynamometer type ammeter/voltmeter by potentiometer.
3. Calibration of dynamometer type wattmeter by potentiometer.
7. Measurement of Capacitance by De Sauty’s Bridge.

Course Outcome:
The students will be able to
1. Understand the working of various electrical measuring instruments.
2. Apply the knowledge about the instruments to use them more effectively.
3. Calculate value of unknown impedance using bridge circuits.
Course Name: Economics for Engineers

Course Code: HMTS3101

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Module I - [6L]

Market: Meaning of Market, Types of Market, Perfect Competition, Monopoly, Monopolistic and Oligopoly market.
The basic concept of economics – needs, wants, utility.
Inflation: meaning, reasons, etc.

Module II - [4L]

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.

Module III - [14L]

Financial Statement Analysis (Ratio and Cash Flow analysis). [8L]

Cost Accounting- Terminology, Fixed, Variable and Semi-variable costs.
Marginal Cost based decisions. [6L]

Module IV - [12L]

Equity and Debt, Cost of Capital. [4L]

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:

Course Name: Communication Techniques

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<tr>
<th>Module I – [10L]</th>
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<tbody>
<tr>
<td>Analog Communication: Introduction to baseband transmission &amp; 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 &amp; 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 &amp; H field, concept on transmission of EM wave (mention of lumped &amp; distributed parameters, line parameters, propagation constant, characteristic impedance, wavelength, velocity of propagation, distortion-less line, reflection and transmission coefficients).</td>
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<th>Module II – [9L]</th>
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<td>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 &amp; QPSK modem, quadrature amplitude modulation (QAM); Delta modulation, adaptive delta modulation (basic concept and applications); Introduction to DPCM and spread spectrum modulation.</td>
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<th>Module III – [13L]</th>
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<td>Digital Transmission: Sampling theorem, sampling rate, impulse sampling, reconstruction from samples, aliasing; analog pulse modulation - PAM (natural &amp; flat topped sampling), PWM, PPM; basic concept of pulse code modulation, block diagram of PCM; Multiplexing - TDM, FDM. Concept of quantization &amp; quantization error, uniform quantizer; non-uniform quantizer, conceptual idea of A-law &amp; μ-law companding; encoding, coding efficiency, source, line coding channel coding &amp; properties, NRZ &amp; RZ, AMI, manchester coding PCM, DPCM; baseband pulse transmission, matched filter (its importance and basic concept), error rate due to noise; error control &amp; coding, nyquist criterion for distortion-less base-band binary transmission, concept of eye pattern, signal power in binary digital signals.</td>
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<th>Module IV – [8L]</th>
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<tr>
<td>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.</td>
</tr>
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</table>

References:
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. Differentiate between base-band transmission and modulation.
2. Compute the coding efficiency of binary and decimal coding systems.
3. Compare the merits and short comings of the basic digital modulation techniques.
4. Calculate the information content, entropy and information rate for given situations.
**Course Name:** Microprocessors- Architecture And Applications  
**Course Code:** AEIE3102

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**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.  

**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.
Course Name: Industrial Instrumentation
Course Code: AEIE3103

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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:
2. D. Patranabis, Principles of industrial Instrumentation; TMH, New Delhi, 2nd Ed.
3. Eckman, Industrial Instrumentation; Wiley Eastern Ltd.
6. K. Krishnaswamy, Industrial Instrumentation; New Age International.
Course Outcome:

After the completion of the course students will be able to

1. Gain the knowledge in the area of pressure, flow, level and temperature transducers.
2. Justify the selection criteria for measurement techniques adopted in industrial environment.
3. Demonstrate working knowledge of safety practices used in the measurement and control of industrial processes.
4. Get idea to calibrate, install and handle the pressure, flow, level and temperature measuring equipments.
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


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. Investigate the time and frequency response of systems and calculate performance indices.
3. Analyze stability of linear systems using different available methods.
4. Understand the concept of state variable representation and design principle.
Course Name: Sensors and Transducers Lab
Course Code: AEIE3111

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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.
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. Analyze the performance characteristics of various transducers and infer the reasons for the behavior.
2. Select an application specific sensor and design a relevant signal conditioning circuit.
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<th>Course Name</th>
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**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. Understand and apply assembly language of microprocessor 8085A.
2. Write programs based on the arithmetical and logical algorithms.
3. Work with microprocessor 8085A interfaced with LEDs, seven segment displays ADC, DAC, and stepper motor etc.
4. Test the hardware interrupts of 8085A.
**Course Name:** Industrial Instrumentation Laboratory  
**Course Code:** AEIE3113

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**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.
7. Level measurement using capacitive/ultrasonic type level transducer.
8. Moisture measurement using moisture analyzer.

**Course Outcome:**

After completion of this course students will be able to

1. Acquire adequate knowledge of pressure, flow, level and temperature measuring instruments.
2. Gain knowledge about the measurement of moisture and viscosity.
3. Handle industrial instruments.
Course Name: Control Engineering Lab

Course Code: AEIE3114

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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.
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 transfer function from block diagram.
3. Design and analyze the characteristics and stability of different processes.
4. Implement control action for effective control and understand the actions of different controllers.
Course Name: Principles of Management
Course Code: HMTS3201

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Module I – [4L]

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.

Module II – [8L]

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.


e) Coordinating: Concepts, issues and techniques.

f) Controlling: Concept, planning-control relationship, process of control, Types of Control, Control Techniques

Module III – [4L]

Span of management, centralization and de-centralization Delegation, Authority & power – Concept & distinction, Line and staff organizations.

Module IV – [8L]

Organization Behaviour: Motivation, Leadership, Communication, Teams and Team Work. [6L]

Management by Objectives (MBO): Management by exception; Styles of management: (American, Japanese and Indian), McKinsey’s 7-S Approach, Self Management. [2L]

References:

2. Stoner, Freeman, Gilbert Jr., Management, PHI.
3. Bhatt & Kumar, Principles of Management, OUP.
Course Name: Process Control  
Course Code: AEIE3201  

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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 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, override, 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:

**Course Outcomes:**

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

1. Write balance equations using first principles modeling and study various control modes.
2. Gain the knowledge of P, PI, PID controller designs and methods of controller tuning.
3. Describe the different types of control valves and identify the types by their inherent flow curves and study various control schemes and processes used in industries.
4. Gain knowledge about different advanced control techniques and familiar with PLC, DCS and SCADA.
Course Name: Electronic Instrumentation and Measurement

Course Code: AEIE3202

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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:
4. D.C. Patranabis, *Principles of Electronic Instrumentation*; PHI.

Course Outcome:

After completion of this course students will be able to

1. Selection of electronic voltmeters and ammeters suitable for typical measurements.
2. Use of electronic instruments like VCO, PLL, current mirror, charge amplifier, V to F and F to V converter.
3. Explain the principle of operation of CRO, some typical oscilloscopes, digital storage oscilloscope and spectrum analyzers.
4. Explain the working of different types of digital voltmeters, digital frequency meter, Q meter, electronic ohmmeters and digital display unit.
Course Name: Advanced Microprocessors and Microcontrollers

Course Code: AEIE3203

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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:


Course outcome:

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

1. Learn the architecture of 8086/8088 microprocessor, 8051 and PIC microcontroller.
2. Develop the skill in program writing for 8086 microprocessor, 8051 and PIC microcontroller.
3. Perform memory and I/O interfacing with 8086 microprocessor.
4. Learn the architecture of different types of programmable peripheral devices and their interfacing with 8086/8088 microprocessor.
5. Apply the knowledge to interface different types of I/O devices with 8051 microcontroller and PIC microcontroller.
Course Name: Fundamentals of Digital Signal Processing

Course Code: AEIE3231

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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:

Course Outcomes:

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. Analyze a discrete linear time invariant system using Z-transform.
3. Understand and apply signal transform algorithms such as Discrete Fourier Transforms (DFT) and Fast Fourier Transform (FFT).
4. Design and implement digital FIR and IIR filters according to the given specification.
Course Name: Mobile Communication
Course Code: AEIE3232

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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]

References:
7. Schiller, Mobile Communication; Pearson Ed.
8. C.Y Lee, Mobile Communication; Wiley.

Course Outcomes:
After the completion of the course students will be able to
1. Describe GSM, CDMA concepts and architecture, frame structure, system capacity, services provided.
2. Understand the evolution of mobile communication generations and others with their characteristics and limitations.
3. Interpret the concept of the wireless local area networks.
4. Justify the selection of indoor and outdoor propagation models related to losses and different types of fading.
Course Name: Opto Electronics and Fibre Optics

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**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:**

**Course Outcomes:**
After the completion of the syllabus, students will be able to:
1. Gain the basic concepts of optoelectronics, properties and industrial and bio-medical applications.
2. Gain the fundamentals of lasers, properties and industrial and bio-medical applications.
3. Gain the fundamentals of optical fibers and their performances, properties and industrial applications industrial and bio-medical applications.

4. Specify and analyze optical optoelectronic devices in optical fiber communication.
**Course Name:** Biomedical Instrumentation  
**Course Code:** AEIE3241

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**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, pO₂, pCO₂ 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.

**Course Outcomes:**
After the completion of the course, the students will be able to
1. Explain the fundamental principles and applications of various sensors and transducers used for measurements of human body parameters.
2. Construct different electrodes and design of signal acquisition systems.
3. Understand the physiological system of human body and identify important parameters.
4. Understand the different methods of medical imaging systems, concepts related to the operations and analysis of biomedical instruments and biotelemetry system.
Course Name: Advanced Sensors
Course Code: AEIE3242

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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:
2. Stephen Beedy, MEMS Mechanical Sensors, Artech House, 2004

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.
Course Name : Non Conventional Energy Sources

Course Code: AEIE3243

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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:

Course Outcomes:

After the completion of the course students will be able to

1. Understand the issue of fuel availability and analyze the supply and demand of fuel in the world.
2. Identify the different sources of renewable energy and innovative technologies in harnessing energy from renewable sources.
3. Explain production of electricity from clean resources.
4. Environmental impacts of a power plant with various resources.
5. Use of wind energy for human usage.
6. Use the conception of the economical use of renewable energy resources over conventional energy sources.
Course Name : Process Control Lab
Course Code: AEIE3211

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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. Construct P & I diagram of various process loops.
2. Acquire knowledge about the effect of the variation of the tuning parameters of the specified controller (P/PI/PID controller) on the process output when step change of set point is given on pressure, level, flow and temperature control loop.
3. Implement ladder diagrams for different control logics in PLC.
4. Acquire knowledge about the single element and three element control of boiler drum level & burner management system in simulation software.
**Course Name:** Electronic Instrumentation and Measurement Lab

**Course Code:** AEIE3212

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**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.
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. Get hand on experience on the use of different electronic and measuring instruments.
2. Use data acquisition system to gather output data from transducer.
3. Able to make statistical analysis on large number of data using MATLAB.
4. Get idea to design some electronic circuits and use these in different applications.
Course Name: Advanced Microprocessors and Microcontrollers Lab
Course Code: AEIE3213

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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. Write assembly language programming using 8086 microprocessor to carry out arithmetic and logical operations.
2. Develop 8051/ PIC 16F or 18F series microcontroller based systems to implement various tasks such as switch state read, development of binary counter, generation of waves, data transfer, etc.
3. Interface different devices like LCD, sensor, motor, key board, etc., with 8051/ PIC 16F or 18F series microcontrollers and write program using them.
4. Design and implement an embedded system using 8051/ PIC 16F or 18F series microcontrollers.
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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. Enhance their presentation and communication skill.
2. Gain information on latest technological upliftment.
3. Strive constantly so as improve the quality of the mentors as well as students.
Subject Name: Telemetry and Remote Control
Paper Code: AEIE4101

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Module I – [11L]

Module II – [9L]

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]

References:
5. Ginz Beng “Fundamentals of Automation and Remote Control”.

Course Outcomes:
After the completion of the course students will be able to
1. Classify telemetry systems and describe modulation processes used in telemetry systems.
2. Justify the need of process data multiplexing and demultiplexing in telemetry.
3. Explain the functions of TT & C subsystems of satellite telemetry systems.
4. Design optical fiber telemetry system.
5. Identify the need of remote control and various methods in existence.
6. Use IoT architecture and explain IoT protocols.
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:

**Course Outcomes:**

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

1. Acquire knowledge about fundamental concepts and techniques used in power electronics.
2. Analyze various single phase and three phase power converter circuits and understand their applications.
3. Confidently interact with the industrial experts for providing consultancy.
4. Develop appropriate power converters for sustainable energy technologies.
**Subject Name:** Advanced Process Control  
**Paper Code:** AEIE4141

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**Module I – [10L]**


**Module II – [10L]**

Digital Control Algorithms: (a) dead beat control, (b) Dahlin’s algorithm, e) 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:**

Course Outcomes:
   After completion of the course students will be able to
1. Analyze process and control in digital domain.
2. Explain different digital control algorithms and enhanced single loop control strategies.
3. Gain knowledge about real time process optimization.
4. Learn different advanced control techniques and be familiar with DCS.
Module I – [7L]
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.

References:
5. J. Yen and R. Langari, *Fuzzy Logic, Intelligence, Control and Information*, Pearson Education.

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.
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\textsubscript{x}, SO\textsubscript{x} and CO\textsubscript{x} and particulate
measurement.
Introduction to hydel power plant, Introduction to nuclear power plant.

References:
   1996.
   International (P) Ltd., 2006.

Course Outcomes:
After completion of the course students will be able to
1. Explain the fundamentals of a power plant along with different important section of
   power plant.
2. Gain the knowledge of basic instrumentation and control loops in power plant.
3. Describe the turbine supervisory instrumentation system.
4. Gain knowledge about water treatment system and Pollution measurement and regulation
   of NO\textsubscript{x}, SO\textsubscript{x} and CO\textsubscript{x}.
Module I – [9L]

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:

Course Outcomes:
After the completion of the course students will be able to
5. Gain the knowledge in the area of pressure, flow, level and temperature transducers.
6. Justify the selection criteria for measurement techniques adopted in industrial environment.
7. Gain the knowledge about different telemetry systems.
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:


Course Outcomes:

After the completion of the course students will be able to

1. Acquire knowledge in the area of embedded system using AVR microcontroller.
2. Justify the selection criteria of microcontrollers needed to adopt in industrial environment for a particular application.
3. Explain the role of operating system in various embedded systems used in industrial applications.
4. Do interfacing of peripherals with AVR microcontrollers and their programming.
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.
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 and handle biotelemetry system used in critical cases.
3. Handle computerized control wireless telemetry system.
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.
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. Design and simulate gate firing circuits.
2. Design and simulate rectifier, chopper and AC voltage controller.
3. Develop skills to build and troubleshoot power electronics circuits.
Module 1: Professional Growth
- 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.
4) Crisis Management: Planning for the Inevitable by Steven Fink. Pub: iUniverseInc.USA.
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 6th – 7th Semester break in reputed Private / Public Sector / Government organization / companies. After completion of this course each student has to submit a report based on their industrial training and give a presentation on the same topic.

**Course Outcomes:**

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

1. Develop understanding about the functioning and organisation of an industry/organisation
2. Interact with other professional and non-professional groups
3. Apply engineering methods such as design and problem solving
4. Develop technical, interpersonal and communication skills, both oral and written
5. Correlate their theoretical understanding with practical implementation
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. Improve in skills to apply knowledge of sensor selection, circuit design, signal processing, conduct experiments, analyze and interpret data.
2. Implement existing or new technology for a proposed project work by applying programming and computing skills using technical software like MATLAB, LAB VIEW, COMSOL etc.
3. Identify, formulate an engineering problem and implement through a scientific manner.
4. Develop ethical and social responsibilities by finding and implementing the needs of society for betterment of life and engage themselves in life-long learning.
Organizational Behaviour

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
Motivation-Definition, Theories of Motivation-Maslow’s Hierarchy of Needs Theory, McGregor’s Theory X&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)

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 conflict process, Conflict resolution techniques, Tools-Johari Window to analyse and reduce interpersonal conflict, Impact on organization. (3L)

Evaluation:
Max. Marks-100
Internal Test-30
Semester End Test-70

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.
Subject Name: Analytical Instrumentation

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, NOx, COx 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
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. Acquire knowledge about analytical techniques to accurately determine the elements present in the given sample.
2. Select instrument for a particular analysis with some idea of its merits, demerits and limitations.
3. Understand the applications and usage of chromatography in real time industrial environments.
4. Gather adequate knowledge of a number of analytical tools, which will be useful for clinical analysis in hospitals, drugs and pharmaceutical laboratories and above all for environmental pollution monitoring.
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 effects.

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:
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. Will be conversant with the fundamental principles of ultrasonic wave generation and propagation.
2. Will have required knowledge on different ultrasonic methods of applications.
3. Will be able to apply the knowledge of ultrasonic instrumentation for non-destructive testing.
4. Will have an idea about the applications of ultrasonic instrumentations in medical sciences.
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]

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
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. Analyze the stability of a control system.
3. Design a discrete controller for specific control systems.
4. Model and identify a process.
Subject Name: Sensor Technology  
Paper Code: AE1E4281

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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:
2. Stephen Beedy, MEMS Mechanical Sensors, Artech House, 2004

Course Outcomes:

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

1. Have the basic concepts of sensors, their properties and industrial applications.
2. Have the fundamental knowledge in micro sensors, sensor materials, properties and industrial applications.
### Subject Name: Control Systems and Applications

**Paper Code: AEIE 4282**

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**Module-1-[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]**

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:**


**Course Outcomes:**

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

5. Develop mathematical model of physical and simulated systems.
6. Investigate the time and frequency response of systems and calculate performance indices.
7. Analyze stability of linear systems using different available methods.
8. Understand the concept and utility of control action and its usage.
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. Appear interview elegantly and confidently.
2. Judge themselves about their domain knowledge.
3. Develop habits of learning.
Subject Name: Technical Seminar II
Paper Code: AEIE 4232

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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. Enhance their presentation and communication skill.
2. Gain information on latest technological developments related to instrumentation, control, communication and other relevant areas related to instrumentation engineering.
3. Carry out literature survey and find out research problems.
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 (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. Manifest themselves in industrial and research ambiences by growing skills and confidence.
2. Solve, analyze and execute technical projects in specified time frame.
3. Develop ethical and social responsibilities by fulfilling the needs of society for betterment of life and engage themselves in life-long learning.
5. Contribute as a member of a group