HERITAGE INSTITUTE OF TECHNOLOGY

(An Autonomous Institution affiliated to MAKAUT, West Bengal)

DEPARTMENT

OF

COMPUTER SCIENCEAND ENGINEERING

(Artificial Intelligence and Machine Learning)

B.TECH. PROGRAMME

Curriculum and Detailed Syllabus

Release Version 1: JULY 2023

Release Version 2: June 2024

(Applicable from 2023 admitted batch)

Table of Contents

Preamble

The curriculum for the B. Tech. in Computer Science and Engineering (Artificial Intelligence and Machine Learning) program has been modified as per the guidelines of AICTE and MAKAUT, and considering the new education policy (NEP) under Academic Regulation 2022 from the academic session 2023 - 2024. In addition, this outcome-based curriculum (OBC) is created with a choice-based credit system (CBCS), which enables students to develop professional competency through a multidisciplinary approach that satisfies the requirements of industry, academics and the different Accreditation bodies like NBA and NAAC. Courses such as Python and R programming, Cloud Computing, Big Data & IoT, Design Thinking and Idea Lab etc. are included in the syllabus keeping in mind the industry demand, as well as the suggestions given by the NBA experts in the very recent visit. Basic mathematical courses like Algebraic structures, linear algebra, and optimization theory are included to strengthen students' mathematical skills that enables them to learn latest developments of computer science and be more innovative. Students are being motivated to select and study Massive Open Online Courses (MOOC) subjects of their choice towards attaining the degree with honors. Apart from this, the course code is now changed from 4 letters to 3 letters from the session 2023 – 2024 as per the suggestions came from the office of the controller of examinations. This will help to distinguish the new course curriculum from the old ones. In accordance with this, the curriculum and syllabi are revised in a structured manner by implementing Feedback Mechanism on Curriculum from various stakeholders, including potential employers, alumni, and parents.

Institutional Vision & Mission

VISION:

To prepare dynamic and caring citizens to meet the challenges of global society while retaining their traditional values.

MISSION:

- To prepare students with strong foundation in their disciplines and other areas of learning.
- To provide an environment for critical and innovative thinking, and to encourage life-long learning.
- To develop entrepreneurial and professional skills.
- To promote research and developmental activities and interaction with industry.
- To inculcate leadership qualities for serving the society.

Departmental Vision & Mission

VISION:

To meet the challenges of 21stcentury and become a Centre of Excellence in the field of Computer Science & Engineering.

MISSION:

M1: To impart the best educational training and facilities to prepare the students with a strong foundation in their disciplines with a penchant for life-long learning and knowledge sharing.

M2: To inculcate a spirit of entrepreneurship and hone their professional skills through developmental activities and interaction with industry.

M3: To promote a culture of research, collaboration and innovation among students and enable them to conceptualize, analyze and solve problems and projects in their fields of interest.

M4: To help students gain perspective of their gifts, talents and interests and encourage them to learn and assess the best ways to lead a venture and respond to the needs of the society.

Program Educational Objectives (PEOs) of B.Tech. in CSE (AI & ML) Programme

The graduate students with the B.Tech. degree in Computer Science and Engineering (Artificial Intelligence and Machine Learning) from Heritage Institute of Technology, Kolkata are expected to achieve the following qualities after a few years of getting this degree.

PEO1. Academic Competence: Graduates will have a strong foundation in mathematical, scientific and computer science & engineering fundamentals with the specialization in Artificial Intelligence and Machine Learning, both theoretical and experimental, that will help in the life-long learning to solve AI and ML- related engineering problems in the industry, to pursue higher studies in AI, ML allied areas to emerge as researchers, educators or experts in those fields and also to acquire necessary skills when a new field emerges in computation or related domain.

PEO2. Application Ability: Graduates will be well-equipped to design, create and analyze new AI products, and provide solutions for real life problems that arise in India or abroad and if required will be confident enough to accept entrepreneurial challenges.

PEO3. Multi-disciplinary Proficiency: Graduates will be interested and confident to venture in multi-disciplinary issues where they engage themselves in resolving AI problems using ML tools in a variety of related domains of activity and also create AI products that require multi-disciplinary skills.

PEO4. Professionalism: Graduates will have high quality professional and ethical attitudes for accepting global challenges and also develop an ability to relate engineering issues to the broader social and environmental context.

PEO5. Leadership and Communication skills: They will acquire leadership abilities, will be able to communicate effectively with others, and also be able to work successfully in teams.

Program Outcomes (POs)

Engineering Graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs) of B.Tech. in CSE (AI & ML) Programme

PSO1. Reflex Action: Students should be able to understand the relevance of Artificial Intelligence and Machine Learning in solving real-life problems. Students should be able to identify the requirements in designing an intelligent computational system. The ability to categorize the different domains or application areas of the sub-problems associated with the system should come to them naturally.

PSO2. Perceptual Action: Students should be able to comprehend and analyze the engineering facets of intelligent systems having learning capability deployed in myriad real-life scenarios. After analyzing the sub-problems, students should be able to describe and capture the complete set of challenges by correctly using appropriate mathematical/logical models.

PSO3. Physical Action: Based on the mathematical/logical models, students should be able to implement the appropriate learning method to operate an intelligent computational system. This will equip students to design efficient algorithms to solve real-world problems while demonstrating professional ethics and concern for societal well-being.

PSO4. Skilled Action: Students should be able to create original models to replicate real-world scenarios. They should be able to propose schemes and design algorithms to implement the model. They will have gained enough expertise to assess the prospective results, measure the efficacy of such solutions and optimize the working parameters of their suggested models. This would allow them to select the most acceptable and useful solution.

Credit Summary for B Tech programme in CSE (AI & ML) with effect from 2023-2024

Sl. No.	Course Type	Credit CSE (AIML)
1.	Humanities and Social Sciences including Management Courses	12
2.	Basic Science Courses	20
3.	Engineering Science Courses including Workshop, Drawing, Basics of Electrical / Mechanical / Computer, etc.	22.5
4.	Professional Core Courses	64
5.	Professional Elective Courses relevant to chosen Specialization / Branch	16.5
6.	Open Subjects – Electives from other Technical and/or Emerging Subjects	12
7.	Project Work, Seminar and Internship in industry or elsewhere	16
8.	Mandatory Courses (Non-credit) [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	(NON-CREDIT)
	Total	**163**
9	Honours Courses (MOOCS or otherwise)	20
	Grand Total	**183**

Definition of Credit (as per National Credit Framework 2022):

- Total notional learning hours = 1200 Hours/ Year
- Minimum credits to be earned = 40/ Year
- 1 Credit = 30 notional learning hours

Range of Credits (as per AICTE):

- A student will be eligible to get B Tech degree with Honours if he/she completes an additional 20 credit points.
- These could be acquired through MOOCs. For details kindly refer to APPENDIX – A.
- A student will be eligible to get B.Tech. degree certificate, if he/ she acquires 100 MAR points in 4 years of their study.
- Lateral entry students must acquire 75 MAR points in their 3 years of study.
- For details kindly refer to APPENDIX – B.

Curriculum

1st Year 1stSemester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	PHY1001	Physics-I	3	0	0	3	3
2	MTH1101	Mathematics-I	3	1	0	4	4
3	ECE1001	Introduction to Electronics Devices & Circuits	3	0	0	3	3
4	HUM1002	Universal Human Values and Professional Ethics	2	1	0	3	3
Total Theory			**11**	**2**	**0**	**13**	**13**
B. Practical							
1	PHY1051	Physics-I Lab	0	0	2	2	1
2	ECE1051	Introduction to Electronics Devices & Circuits Lab	0	0	2	2	1
3	MEC1051	Workshop / Manufacturing Practice	1	0	3	4	2.5
4	MEC1052	Engineering Graphics and Design	1	0	3	4	2.5
Total Practical			**2**	**0**	**10**	**12**	**7**
Total of Semester			**13**	**2**	**10**	**25**	**20**

1st Year 2nd Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	CHM1001	Chemistry-I	3	0	0	3	3
2	MTH1201	Mathematics-II	3	1	0	4	4
3	CSE1001	Programming for Problem Solving	4	0	0	4	4
4	ELE1001	Basic Electrical Engineering	3	1	0	4	4
5	HUM1001	English for Technical Writing	2	0	0	2	2
Total Theory			**15**	**2**	**0**	**17**	**17**
B. Practical							
1	CHM1051	Chemistry-I Lab	0	0	2	2	1
2	CSE1051	Programming for Problem Solving Lab	0	0	3	3	1.5
3	ELE1051	Basic Electrical Engineering Lab	0	0	2	2	1
4	HUM1051	English for Technical Writing Lab	0	0	2	2	1
Total Practical			**0**	**0**	**9**	**9**	**4.5**
Total of Semester			**15**	**2**	**9**	**26**	**21.5**

2nd Year 1st Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	CSE2101	Data Structures and Algorithms	4	0	0	4	4
2	DSC2101	Python Programming	3	0	0	3	3
3	AML2101	Data Mining	3	0	0	3	3
4	MTH2102	Probability and Statistical Methods	4	0	0	4	4
5	MTH2103	Discrete Mathematics	4	0	0	4	4
Total Theory			**18**	**0**	**0**	**18**	**18**
B. Practical							
1	CSE2151	Data Structures and Algorithms Lab	0	0	3	3	1.5
2	DSC2151	Python Programming Lab	0	0	2	2	1
3	AML2151	Data Mining Lab	0	0	3	3	1.5
4	AML2155	Design Thinking and Idea Lab (CSE (AI & ML))	0	0	2	2	1
Total Practical			**0**	**0**	**10**	**10**	**5**
Total of Semester			**18**	**0**	**10**	**28**	**23**

2nd Year 2nd Semester

Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
A. Theory							
1	CSE2201	Design & Analysis of Algorithms	4	0	0	4	4
2	CSE2202	Computer Organization and Architecture	4	0	0	4	4
3	AML2201	Introduction to Artificial Intelligence	4	0	0	4	4
4	ECE2002	Digital Circuit Design	4	0	0	4	4
5	AEI2206	Introduction to Smart Sensing Technology for AI	3	0	0	3	3
6	EVS2016	Environmental Sciences (Mandatory)	2	0	0	2	0
Total Theory			**21**	**0**	**0**	**21**	**19**
B. Practical							
1	CSE2251	Design & Analysis of Algorithms Lab	0	0	3	3	1.5
2	CSE2252	Computer Architecture Lab	0	0	3	3	1.5
3	AML2251	AI Lab	0	0	3	3	1.5
4	ECE2052	Digital Circuit Design Lab	0	0	3	3	1.5
Total Practical			**0**	**0**	**11**	**11**	**6**
Total of Semester			**21**	**0**	**11**	**32**	**25**

3rd Year 1st Semester

Sl.	Code	Subject	Contacts Periods/ Week L	T	P	Total	Credit Points
A. Theory							
1	CSE3101	Database Management Systems	4	0	0	4	4
2	AML3001	Fundamentals of Machine Learning	3	0	0	3	3
3	AML3102	Introduction to Operating Systems	3	0	0	3	3
4	XXX3131-XXX3140	Professional Elective-I	3	0	0	3	3
	CSE3133	Web Technologies					
	CSE3135	Randomized Algorithms					
	AML3131	Introduction to Soft Computing					
	AML3133	Introduction to Information Retrieval					
	MTH3131	Linear Algebra for Data Analysis					
5	AML3141-AML3150	Professional Elective-II	3	0	0	3	3
	AML3141	Introduction to Image Processing					
	AML3142	Fundamentals of Computer Networks					
	AML3143	Introduction to Software Engineering					
	AML3144	Introduction to Object Oriented Programming					
6		Open Elective-I	3	0	0	3	3
	AEI3122	Fundamentals of Sensors & Transducers					
	CHE3121	Water and Liquid Waste Management					
	CHE3122	Industrial Safety and Hazards					
	ECE3123	Error Control Coding for Secure Data Transmission					
	ECE3124	Introduction to VLSI Design					
	MEC3121	Additive Manufacturing					
	MEC3123	Total Quality Management (TQM)					
Total Theory			**19**	**0**	**0**	**19**	**19**
B. Practical							
1	CSE3151	Database Management Systems Lab	0	0	3	3	1.5
2	AML3051	Fundamentals of Machine Learning Lab	0	0	3	3	1.5
3	AML3152	Introduction to Operating Systems Lab	0	0	2	2	1
4	AML3171-AML3180	Professional Elective - II LAB	0	0	2	2	1
	AML3171	Introduction to Image Processing Lab					
	AML3172	Fundamentals of Computer Networks Lab					
	AML3173	Introduction to Software Engineering Lab					
	AML3174	Introduction to Object Oriented Programming Lab					
Total Practical			**0**	**0**	**11**	**11**	5
Total of Semester			**19**	**0**	**11**	**30**	**24**

3rd Year 2nd Semester

Sl.	Code	Subject	Contacts Periods/ Week L	T	P	Total	Credit Points
A. Theory							
1	CSE3002	Formal Language & Automata Theory	4	0	0	4	4
2	AML3202	Deep Learning	3	0	0	3	3
3	HUM3201	Economics for Engineers	3	0	0	3	3
4	XXX3231 - XXX3240	Professional Elective-III	3	0	0	3	3
	CSE3232 CSE3234 CSE3235 IOT3231	Enterprise Application in Java EE Compiler Design Cloud Computing Big Data and IoT					
6	*****	Open Elective-II	3	0	0	3	3
7	INC3016	Indian Constitution and Civil Society (Mandatory)	2	0	0	2	0
Total Theory			**18**	**0**	**0**	**18**	**16**
B. Practical							
1	AML3252	Deep Learning Lab	0	0	3	3	1.5
2	XXX3261- XXX3270	Professional Elective-III Lab	0	0	2	2	1
	CSE3262 CSE3264 CSE3265 IOT3261	Enterprise Application in Java EE Lab Compiler Design Lab Cloud Computing Lab Big Data and IOT Lab					
Total Practical			**0**	**0**	**5**	**5**	**2.5**
C. Sessional							
1	AML3293	Term Paper and Seminar	0	0	4	4	2
2	AML3295	Project-I	0	0	4	4	2
Total Sessional			**0**	**0**	**8**	**8**	**4**
Total of Semester			**18**	**0**	**13**	**31**	**22.5**

4th Year 1st Semester

A. Theory							
			Contacts Periods/ Week				
Sl.	Code	Subject	L	T	P	Total	Credit Points
1	HUM4101	Principles of Management	3	0	0	3	3
2	XXX4131 - XXX4140	Professional Elective-IV	3	0	0	3	3
	AML4131 AML4132 AML4133 CSE4132 CSE4136	Stochastic Theory Introduction to Robotics Fundamentals of Business Analytics Cryptography & Network Security Mobile Computing					
3	XXX4141 - XXX4150	Professional Elective-V	3	0	0	3	3
	CSE4141 CSE4143 CSE4145 CSE4146 AML4141	Natural Language Processing Pattern Recognition Social Network Analysis Computer Vision Web Mining and its Applications					
4	****	Open Elective-III	3	0	0	3	3
5	****	Open Elective-IV	3	0	0	3	3
Total Theory			**15**	**0**	**0**	**15**	**15**
B. Sessional							
1	AML4191	Industrial Training / Internship	-	-	-	-	**2**
2	AML4195	Project-II	0	0	6	6	3
Total Sessional			**0**	**0**	6	6	**5**
Total of Semester			**15**	**0**	**6**	**21**	**20**

4th Year 2nd Semester

Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	AML4295	Project-III	0	0	10	10	5
2	AML4297	Comprehensive Viva-voce	-	-	-	-	2
Total Sessional			**0**	**0**	**10**	**10**	**7**
Total of Semester			**0**	**0**	**10**	**10**	**7**

DETAILED SYLLABUS

1st Year

FIRST YEAR
FIRST SEMESTER

Course Title : Physics-I					
Course Code: PHY1001					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

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

PHY1001.1: Understand physical systems in terms of their modelling of time evolution.
PHY1001.2: Comprehend wave interpretation of natural phenomena and implications of allied observations.
PHY1001.3: Understand theoretical backgrounds associated to some experiments based on wave phenomena.
PHY1001.4: Grasp an analytic view of micro and macroscopic world.
PHY1001.5: Access the knowledge of the behaviour of a particle under the influence of different potential.
PHY1001.6: Understand conservative systems based on their particle and wave nature.

Detailed Syllabus:

Module – I: [10L]

Mechanics:

Plane-polar coordinate system-velocity and acceleration of a particle-trajectory under central force-conservation principle-Kepler's laws -Rotating frame of reference-Five point acceleration formula-Coriolis effect-deflection of a moving particle.

Module – II: [10L]
Oscillation:

Constitutive equation of damping-nature of solutions for large, critical and weak damping-relaxation time, logarithmic decrement, energy decay (qualitative discussion) -Forced oscillation-transient and steady state-amplitude and velocity resonance---power transfer theorem-quality factor-series LCR circuit with AC source.

Module –III: [10L]

Optics:

Plane Progressive Wave-phase/wave-length/frequency-qualitative description of light as an electromagnetic wave-Huygens principle-polarization (state of polarization, general equation of ellipse, transformation of polarized lights)-interference (basic theory from superposition principle)-Division of wave front (Young's double slit experiment)-Division of amplitude (thin film, wedge, Newton's ring)-Diffraction (single slit, double slit, grating, Resolving Power).

Module – IV: [10L]

Quantum Mechanics:

An informal discussion from Planck to de Broglie as the historical context of quantum mechanics-Quantum Mechanics of a particle-operator-eigenvalue problem- Unitary-Hermitian frame work-position and momentum operator-Canonical Commutation Relations (CCR)-Schrodinger equation-time dependent/time independent Schrodinger equation-wave function-stationary states-probability density-probability current density-normalization-expectation value-uncertainty-Bound state problem-particle in a one dimensional box- scattering state problem-potential step-reflection and transmission coefficients- tunnelling.

BOOKS

1. Theoretical Mechanics : M R Spiegel (Schaum Series) McGrow-Hill Book Company
2. Classical Mechanics: N C Rana and P S Joag Tata- McGrow-Hill Publishing Company Limited.
3. Vibrations and Waves : A P French, W W Norton and Company,
4. The Physics of Waves and Oscillations : N K Bajaj, Tata- McGrow-Hill Publishing Company Limited.
5. Optics: A Ghatak, Tata McGraw-Hill Publishing Company Limited.
6. Optics : E. Hecht, Addison Wesley
7. Fundamentals of Optics: F A Jenkins and H E White, McGrow-Hill Higher Education.
8. Atomic Physics (Modern Physics): S N Ghosal, S. Chand and Company.
9. Practical Quantum Mechanics : S Flugge, Springer (Reprint of the 1994 Edition)
10. Concepts of Modern Physics: A Baiser, Tata McGraw-Hill Publishing Company Limited.

Refresher Course in B.Sc. Physics – Vol1 and Vol 2 – C.L.Arora

Course Title : Mathematics-I					
Course Code: MTH1101					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Course Outcomes:

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

MTH1101.1 Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.
MTH1101.2 Develop the concept of eigen values and eigen vectors.
MTH1101.3 Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.
MTH1101.4 Analyze the nature of sequence and infinite series
MTH1101.5 Choose proper method for finding solution of a specific differential equation.
MTH1101.6 Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

Detailed Syllabus:
Module I: [10L]

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

Module II: [10L]

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

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

Module III: [10L]

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

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

Module IV: [10L]

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

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

References:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2000.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. K. F. Riley, M. P. Hobson, S. J. Bence. Mathematical Methods for Physics and Engineering, Cambridge University Press, 23-Mar-2006.
6. S. L. Ross, Differential Equations", Wiley India, 1984.
7. G.F. Simmons and S.G. Krantz, Differential Equations, McGraw Hill, 2007.
8. Vector Analysis(Schaum's outline series): M. R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
9. Engineering Mathematics: S. S. Sastry (PHI)
10. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP),Indian Edition.
11. Linear Algebra (Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)

Course Title : Introduction to Electronics Devices & Circuits					
Course Code: ECE1001					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

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

ECE1001.1 Categorize different semiconductor materials based on their energy bands and analyze the change in characteristics of those materials due to different types of doping.
ECE1001.2 Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode.
ECE1001.3 Design different application specific circuits using diodes.
ECE1001.4 Analyze various biasing configurations of Bipolar Junction Transistor.
ECE1001.5 Categorize different field-effect transistors and analyze their behavior.
ECE1001.6 Design and implement various practical electronic circuits.

Detailed Syllabus:

Module I [10 L]
Basic Semiconductor Physics:
Crystalline materials, energy band theory, Conductors, Semiconductors and Insulators, Concept of Fermi energy level, intrinsic and extrinsic semiconductors, mass action law, drift and diffusion currents in semiconductor, Einstein relation.
Diodes and Diode Circuits:
Formation of p-n junction, energy band diagram, forward & reverse biased configurations, V-I characteristics, DC load line, breakdown mechanisms - Zener and avalanche breakdown, voltage regulation using Zener diode.
Rectifier circuits: half wave & full wave rectifiers: ripple factor, rectification efficiency, light emitting diode.

Module II [8L]
Bipolar Junction Transistors (BJT):
PNP & NPN BJT structures, different operating modes of BJT, current components in BJT, dc current gains in CE & CB configurations and their interrelation, input & output V-I characteristics of CE & CB configurations. Concept of Biasing: DC load line, Q-point, basic concept of amplification using BJT.

Module III [9L]

Field Effect Transistors (FET):

Classification of FET, basic structure and operation of Junction Field Effect Transistor (n-channel) along with its V-I characteristics.

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

Module IV [9L]

Feedback in amplifiers:

Concept of feedback, different feedback topologies using block diagram only, effects of negative feedback

(qualitative), Barkhausen criteria for sustained oscillation.

Operational Amplifier:

Usefulness of differential amplifier over single ended amplifier, ideal OPAMP characteristics, CMRR, slew rate, offset error voltages and current

Basic circuits using OPAMP: Comparator, inverting and non-inverting amplifiers, adder, subtractor, integrator, differentiator.

References:

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

Course Name: **Universal Human Values and Professional Ethics**					
Course Code : HUM1002					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	1	0	3	3

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

HUM1002.1 appreciate the essential complementarity between 'values' and 'skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
HUM1002.2 develop a Holistic perspective towards life and profession.
HUM1002.3 develop a correct understanding of the Human reality and the rest of existence.
HUM1002.4 appreciate the relationship of values in terms of ethical human conduct.
HUM1002.5 understand the importance of trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
HUM1002.6 differentiate between the characteristics and activities of different orders and study the mutual fulfilment among them.

Detailed Syllabus:
Module I [6L]

Introduction to Value Education

Understanding Values: Historical perspective to the development of values and its importance for the integration and harmony of the self and body
Understanding Human being as the Co-existence of the Self and the Body
Exploring Harmony of Self with the Body
Distinguishing between the Needs of the Self and the Body
Understanding and appreciating basic human aspirations-Maslow's Hierarchy of Needs Theory
Strategies, Methods to Fulfil the Basic Human Aspirations
Continuous Happiness and Prosperity – the Basic Human Aspirations

Module II [10L]

Harmony in the Family and Society

The self as a social being starting with the family as the smallest unit — the process of socialisation.
Development of the self in relation to the society – Cooley's and Mead's theories of socialisation.
Self and Integrated personality - Morality, Courage and Integrity
Conflict of interest at home and society and its resolution through the implementation of the Human Values

Societal Values – Justice, Democracy and Rule of law
Establishing harmony in the society with the help of ethical conduct based on values- Ethics of Rights and Duties, Ethics of care, Ethics of Justice and Fairness, Work Ethics and quality of life at work.
Value crisis- disharmony in relationships, understanding harmony in the society
Solutions - contribution of the individual in establishing harmony in the society.
'Trust' and 'Respect'--the Foundational Values in Relationship
Exploring the Feeling of Trust and Respect

Module III [10L]

Implications of the Holistic Understanding – a Look at Professional Ethics

Ethics and Ethical Values

Principles and theories of ethics--Consequential and non-consequential ethics, Utilitarianism, Kant's theory and other non-consequential perspectives

Professional Ethics- Right understanding of Professional Ethics

Canons of professional Ethics

Technology – various perspectives-its use, overuse and misuse

Privacy, data security and data protection, Artificial intelligence-harmony or disharmony,

misinformation, deep fake, cyber-crime - a sociological perspective.

Code of Ethics, Violation of code of ethics, Whistle blowing, Institutionalising Ethics

Vision for the Universal Human Order, Exploring Systems to fulfil Human Endeavours

Module IV [10L]

Harmony in the Nature/ Existence

Understanding Harmony in the Nature -Ecological Ethics

Sustainable development- Definition and Concept

Strategies for sustainable development- Small is beautiful, Slow is Beautiful

Sustainable Development--- The Modern Trends

Sustainable Development Goals- Case studies and Best practices

Exploring the Four Orders of Nature -Interconnectedness, self-regulation and Mutual Fulfilment

among the Four Orders of Nature

The Holistic Perception of Harmony in Existence

Suggested Readings:

1. A Foundation Course in Human Values and Professional Ethics, R.R. Gaur, R. Asthana, G.P. Bagaria, Excel Books Pvt. Ltd. New Delhi

2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book).

4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5. Small is Beautiful - E. F Schumacher.

6. Slow is Beautiful - Cecile Andrews

Course Title : Physics-I Lab					
Course Code: PHY1051					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Course Outcomes:

PHY1051.1: Applying practical knowledge using the experimental methods to correlate with the Physics theory.

PHY1051.2: Understanding the usage of electrical and optical systems for various measurements.

PHY1051.3: Applying the analytical techniques and graphical analysis to the experimental data.

PHY1051.4: Understanding measurement technology, usage of new instruments and real time applications in engineering studies.

PHY1051.5: Evaluating intellectual communication skills and discuss the basic principles of scientific concepts in a group.

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

Group I: Experiments in Optics

1. Determination of dispersive power of the material of a prism

2. Determination of wavelength of a monochromatic light by Newton's ring

3. Determination of wavelength of the given laser source by diffraction method

Group II: Electricity & Magnetism experiments

1. Determination of specific charge (e/m) of electron by J.J. Thompson's method.

2. Determination of dielectric constant of a given dielectric material.

3. Determination of Hall coefficient of a semiconductor by four probe method.

4. To study current voltage characteristics, load response, areal characteristic and spectral response of a photovoltaic solar cell.

5. Determination of Magnetic Field Measurement for a current carrying coil.

6. Determination of unknown resistance using Carey Foster's bridge

Group III: Experiments in Quantum Physics

1. Determination of Stefan-Boltzmann constant.

2. Determination of Planck constant using photocell.

3. Determination of Lande-g factor using Electron spin resonance spectrometer.

4. Determination of Rydberg constant by studying Hydrogen spectrum.

5. Determination of Band gap of semiconductor.

Group IV: Miscellaneous experiments

1. Determination of Young's modulus of elasticity of the material of a bar by the method of flexure

2. Determination of bending moment and shear force of a rectangular beam of uniform cross section

3. Determination of modulus of rigidity of the material of a rod by static method

4. Determination of rigidity modulus of the material of a wire by dynamic method

5. To determine the moment of inertia of a body about an axis passing through its centre of gravity and to determine the modulus of rigidity of the material of the suspended wire

6. Determination of coefficient of viscosity by Poiseulle's capillary flow method

Books of reference:

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

Course Title : Introduction to Electronics Devices & Circuits Lab					
Course Code: ECE1051					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Course Outcomes:

ECE1051.1 The students will correlate theory with diode behavior.
ECE1051.2 They will design and check rectifier operation with regulation etc.
ECE1051.3 Students will design different modes with BJT and FET and check the operations.
ECE1051.4 They will design and study adder, integrator etc. with OP-AMPs.

List of Experiments

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

Course Title : Workshop/Manufacturing Practice					
Course Code: MEC1051					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**3**	**4**	**2.5**

Course Outcomes:

On successful completion of the course, students will be able to

MEC1051.1: **Follow** the various safety practices in workshop and personal protective elements.

MEC1051.2: **Identify** tools, work material and measuring instruments useful for fitting, carpentry and sheet metal practices.

MEC1051.3: **Operate** machine tools, components and processes to prepare jobs of specific shape and size.

MEC1051.4: **Acquire** knowledge of foundry process and casting of a product.

MEC1051.5: **Perform** welding, brazing and soldering processes.

MEC1051.6: **Assemble** a simple product.

Syllabus:

(i) Lectures: (13 hours)

Detailed contents

1. Introduction on Workshop and familiarization with safety norms	**(1 lecture)**
2. Carpentry and Fitting	**(2 lectures)**
3. Sheet metal	**(1 lecture)**
4. Metal casting	**(1 lecture)**
5. Welding (arc welding & gas welding), brazing and soldering	**(2 lectures)**
6. Manufacturing Methods- machining (Lathe, Shaping and Milling)	**(4 lectures)**
7. Additive manufacturing	**(1 lecture)**
8**.** Assembling of a product	**(1 lecture)**

(ii) Workshop Practice: (39 hours)

1. Safety practices in workshop	**(3 hours)**
2. Carpentry shop	**(3 hours)**
3. Fitting shop	**(6 hours)**
4. Foundry shop	**(3 hours)**
5.Machine shop	**(9 hours)**
6. Welding shop-Arc welding	**(3 hours)**
7. Sheet metal shop and brazing	**(6 hours)**
8. Soldering operation	**(3 hours)**
9**.** Assembling of a product	**(3 hours)**

Suggested Text/Reference Books:

1. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., "Elements ofWorkshop Technology", Vol. I 2008 and Vol. II 2010, Media promotersandpublishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice HallIndia, 1998.
5. 5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Title : Engineering Graphics and Design					
Course Code: MEC1052					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**3**	**4**	**2.5**

Course Outcomes:

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

MEC1052.1 understand the meaning of engineering drawing.

MEC1052.2 acquaintance with the various standards (like lines, dimensions, scale etc.) and symbols followed in engineering drawing.

MEC1052.3 represent a 3-D object into 2-D drawing with the help of orthographic and isometric projections.

MEC1052.4 read and understand projection drawings.

MEC1052.5 draw the section view and true shape of a surface when a regular object is cut by a section plane.

MEC1052.6 use engineering drawing software (CAD).

Lecture Plan (13 L)

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

Detailed contents of Lab hours (52 hrs)

Module 1: Introduction to Engineering Drawing covering,

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lines, lettering & dimensioning, Conic section like Ellipse (General method only); Involute; Scales – Plain, Diagonal. (4 hrs + 4 hrs)

Module 2: Orthographic Projections covering,

Principles of Orthographic Projections - Conventions - Projections of Points and lines inclined to both planes; Projections on Auxiliary Planes. Projection of lamina.

(4 hrs+4 hrs + 4 hrs)

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

(4 hrs + 4 hrs)

Module 4: Sections and Sectional Views of Right Angular Solids covering,

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids.(4 hrs)

Module 5: Isometric Projections covering,

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions. (4 hrs + 4 hrs)

Module 6: Overview of Computer Graphics covering,

listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids. (4 hrs)

Module 7: Customisation & CAD Drawing

consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; (2 hrs)

Annotations, layering & other functions covering

applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of

composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation. (2 hrs)

Module 8: Demonstration of a simple team design project that illustrates

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame.

(4 hrs)

References:

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

FIRST YEAR
SECOND SEMESTER

Course Title : Chemistry-I					
Course Code : CHM1001					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course outcomes:

The subject code CHM 1001 corresponds to chemistry theory classes for the first year B. Tech students, which is offered as Engineering Chemistry and is common for all branches of engineering subjects. The course provides basic knowledge of theory based subjects like quantum mechanics, thermodynamics, reaction dynamics, electrochemistry, structure and reactivity of molecules. The course outcomes of the subject are

CHM1001.1 Knowledge of understanding the operating principles and reaction involved in batteries and fuel cells and their application in automobiles as well as other sectors to reduce environmental pollution.

CHM1001.2 An ability to design and conduct experiments, as well as to organize, analyzes, and interprets data.

CHM1001.3 An ability to analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces for engineering applications.

CHM1001.4 Have knowledge of synthesizing nano materials and their applications in industry, carbon nano tube technology is used in every industry now-a-days.

CHM1001.5 Understanding of bulk properties and processes using thermodynamic considerations.

CHM1001.6 Elementary knowledge of IR, UV, NMR and X-ray spectroscopy is usable in structure elucidation and characterisation of various molecules. Knowledge of electronic effect and stereochemistry for understanding mechanism of the major chemical reactions involved in synthesis of various drug molecules.

Detailed Syllabus:

Module I [10 L]

Atomic structure and Wave Mechanics:

Brief outline of the atomic structure, Duel character of electron, De Broglies's equation, the Heisenberg uncertainty principle, brief introduction of quantum mechanics, the Schrodinger

wave equation, Hermitian operator, solution of the Schrodinger equation for particle in a one dimensional box, interpretation of the wave function Ψ, concept of atomicorbital. 3L

Thermodynamics:

Carnot cycle, 2nd law of thermodynamics, entropy, Clausius inequality, free energy and work function, Clausius Clapeyron Equation, Chemical Potential, Activity and Activity coefficient. Gibbs Duhem Relation. 4L

Spectroscopic Techniques & Application

Electromagnetic spectrum: EMR interaction with matter - absorption and emission of radiation. Principle and application of UV- visible and IR spectroscopy

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

ModuleII [10 L]

Chemical Bonding

Covalent bond, VSEPR Theory, hybridization, molecular geometries, Dipole moment, Intermolecular forces, V.B. and M.O. theory and its application in Homo and Heteronuclear diatomic molecules, Band theory of solids, Pi- molecular orbital of ethylene and butadiene.5L

Periodicity

Effective nuclear charge, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro-negativity, inert pair effect.3L

Ionic Equilibria

Acid Base Equilibria, Salt Hydrolysis and Henderson Equation, Buffer solutions, pH indicator, Common ion Effect, Solubility product, Fractional Precipitation .2L

ModuleIII [10 L]

Conductance

Conductance of electrolytic solutions, Strong and Weak electrolytes, effect of temperature and concentration. Kohlrausch's law of independent migration of ions, transport numbers and hydration of ions. Application of conductance Acid-base and precipitation titration. 3L

Electrochemical Cell

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

Electrochemical Energy Conversion: Primary & Secondary batteries, Fuel Cells. 4L

Reaction dynamics

Rate Laws, Order &Molecularity; zero, first and second order kinetics.Pseudo-unimolecular reaction, Arrhenius equation.

Mechanism and theories of reaction rates (Transition state theory, Collison theory). Catalysis: Homogeneous catalysis (Definition, example, mechanism, kinetics). 3L

Module IV [10L]

Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.4L

Structure and reactivity of Organic molecule

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

Organic reactions and synthesis of drug molecule

Introduction to reaction mechanisms involving substitution, addition, elimination and oxidation- reduction reactions. Synthesis of commonly used drug molecules.3L

TEXT BOOKS

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

REFERENCE BOOKS

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

Course Title: Mathematics-II					
Course Code: MTH1201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes

MTH1201.1. Demonstrate the knowledge of probabilistic approaches to solve wide range of engineering problem.

MTH1201.2. Recognize probability distribution for discrete and continuous variables to quantify physical and engineering phenomenon.

MTH1201.3. Develop numerical techniques to obtain approximate solutions to mathematical problems where analytical solutions are not possible to evaluate.

MTH1201.4. Analyze certain physical problems that can be transformed in terms of graphs and trees and solving problems involving searching, sorting and such other algorithms.

MTH1201.5. Apply techniques of Laplace Transform and its inverse in various advanced engineering problems.

MTH1201.6. Interpret differential equations and reduce them to mere algebraic equations using Laplace Transform to solve easily.

The objective of this course is to familiarize the students with numerical techniques, integral transforms, graph theory and probability. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

Detailed Syllabus:

Module-I Fundamentals of Probability [10L]

Random experiment, Sample space and events

Classical and Axiomatic definition of probability

Addition and Multiplication law of probability

Conditional probability

Bayes' Theorem

Random variables

General discussion on discrete and continuous distributions

Expectation and Variance

Examples of special distribution: Binomial and Normal Distribution

Module-II Numerical Methods [10L]

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

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

Solution of Ordinary differential equations: Euler's and Modified Euler's Method, Runge-Kutta Method of 4th order.

Module-III Basic Graph Theory [10L]

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

Definition and properties of a tree

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-IV Laplace Transformation [10L]

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

Introduction to integral transformation

Functions of exponential order, Definition and existence of Laplace Transform (LT) (statement of initial and final value theorem only)

LT of elementary functions, Properties of Laplace Transformations, Evaluation of sine, cosine and exponential integrals using LT

LT of periodic and step functions

Definition and properties of inverse LT

Convolution Theorem (statement only) and its application to the evaluation of inverse LT

Solution of linear ODEs with constant coefficients (initial value problem) using LT

Suggested Books:

1. Advanced Engineering Mathematics , E.Kreyszig, Wiley Publications
2. Introduction to Probability and Statistics for Engineers and Scientists, S.Ross, Elsevier
3. Introductory methods of Numerical Analysis, S.S. Sastry, PHI learning
4. Introduction to Graph Theory, D. B. West, Prentice-Hall of India
5. Engineering Mathematics, B.S. Grewal, S. Chand & Co.

Course Title: Programming for Problem Solving					
Course Code: CSE1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	0	0	4	4

Course Outcomes:

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

CSE1001.1: Remember and understand the functionalities of the different hardware and software components present in a computer system, the standard representations of various types of data in a computer system.

CSE1001.2: Illustrate how a computer system with one way of representation can be converted to one another equivalent representation.

CSE1001.3: Construct flow charts for any arithmetic or logical problems in hand.

CSE1001.4: Remember and understand the C programming development environment, writing, compiling, debugging, linking and executing a C program using that development environment, basic syntax and semantics of C programming language and interpret the outcome of any given C program.

CSE1001.5: Use loop constructs, conditional branching, iteration, recursion to solve simple engineering problems.

CSE1001.6: Apply pointers, arrays, structures, files to formulate simple engineering problems.

Detailed Syllabus:

Module I: [12L] Fundamentals of Computer

History of Computers, Generations of Computers, Classification of Computers.

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

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

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

Module II: [12L] Basic Concepts of C

C Fundamentals:

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements. Operators & Expressions:

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

Flow of Control:

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

Module III: [12L] Program Structures in C

Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes -

auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables. C pre-processor (macro, header files), command line arguments.

Arrays and Pointers:

One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality.

String and character arrays; C library string functions and their use.

Module IV: [12L] Data Handling in C

User defined data types and files:

Basic of structures; structures and functions; arrays of structures.

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

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

Course Title: Basic Electrical Engineering					
Course Code: ELE1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes

After attending the course, the students will be able to

ELE1001.1 Analyse DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.

ELE1001.2 Analyse DC Machines; Starters and speed control of DC motors.

ELE1001.3 Analyse magnetic circuits.

ELE1001.4 Analyse single and three phase AC circuits.

ELE1001.5 Analyse the operation of single phase transformers.

ELE1001.6 Analyse the operation of three phase induction motors.

Detailed Syllabus:

Module-I: [11L]

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

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

Module-II[10L]

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

Module-III [11L]

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

DC Machines: Construction, EMF equation, Principle of operation of DC generator, Open circuit characteristics, External characteristics, Principle of operation of DC motor, speed-torque

characteristics of shunt and series machine, starting of DC motor, speed control of DC motor.[7L]

Module-IV [10L]

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

Three-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.[4L]

Text Books:

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

Reference Books:

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

Course Title: English for Technical Writing					
Course Code: HUM1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	2	0	0	2	2

Course Outcomes:

After attending the course, the students will be able to

HUM1001.1: Communicate effectively in an official and formal environment
HUM1001.2: Use language as a tool to build bridges and develop interpersonal relations in multi-cultural environments
HUM1001.3: Use various techniques of communication for multiple requirements of globalized workplaces
HUM1001.4: Learn to articulate opinions and views with clarity.

HUM1001.5: Write business letters and reports.

HUM1001.6: Apply various communication strategies to achieve specific communication goals.

Module- I (6L)

Introduction to Phonology and Morphology

- Phonetics- Vowel and Consonant Sounds (Identification & Articulation)
- Word- stress, stress in connected speech
- Intonation (Falling and Rising Tone)
- Vocabulary Building-The concept of Word Formation

Module- II (6L)

Communication Skills

- The Basics of Business Communication- Process, types, levels
- Barriers to Communication Common obstacles to effective communication
- Approaches and Communication techniques for multiple needs at workplace: persuading, convincing, responding, resolving conflict, delivering bad news, making positive connections
- Identify common audiences and design techniques for communicating with each audience

Module- III (6L)

Organizational Communication

- Business Letters
- Organizational Communication: Agenda & minutes of a meeting, Notice, Memo, Circular
- Organizing e-mail messages, E-mail etiquette
- Techniques for writing precisely: Creating coherence, organizing principles –accuracy, clarity, brevity. Different styles of writing: descriptive, narrative, expository.

Module- IV (6L)

Principles, techniques and skills for professional writing

- Logic in writing, thinking and problem-solving; applying deductive and inductive reasoning; Use of infographics in writing.
- Report Writing: Importance and Purpose, Types of Reports, Report Formats, Structure of Formal Reports, Writing Strategies. Interpreting data and writing reports
- Writing proposals and Statement of purpose

Text Books:

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

Reference Books:

1. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA: Advanced Communication Designs.
2. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.

Course Title : Chemistry-I Lab					
Course Code : CHM1051					
Contact hrs. per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Course outcomes:

The subject code CHM1051 corresponds to chemistry laboratory classes for the first year B. Tech students. This course enhances the students' experience regarding handling of various chemicals along with various laboratory equipment. Hands on experiments increase the depth of knowledge that is taught in the theory classes as well as it increases research aptitude in students because they can see the direct application of theoretical knowledge in practical field. The course outcomes of the subject are

CHM1051.1 Knowledge to estimate the hardness of water which is required to determine the usability of water used in industries.

CHM1051.2 Estimation of ions like Fe^{2+}, Cu^{2+} and Cl^{-} present in water sample to know the composition of industrial water.

CHM1051.3 Study of reaction dynamics to control the speed and yield of various manufactured goods produced in polymer, metallurgical and pharmaceutical industries.

CHM1051.4 Handling physico-chemical instruments like viscometer, stalagmometer, pH-meter, potentiometer and conductometer.

CHM1051.5 Understanding the miscibility of solutes in various solvents required in paint, emulsion, biochemical and material industries.

CHM1051.6 Knowledge of sampling water can be employed for water treatment to prepare pollution free water.

List of Experiments:

1. Estimation of iron using KMnO4: self indicator.
2. Iodometric estimation of Cu^{2+}.
3. Determination of Viscosity.
4. Determination of surface tension.
5. Adsorption of acetic acid by charcoal.
6. Potentiometric determination of redox potentials.
7. Determination of total hardness and amount of calcium and magnesium separately in a given water sample.
8. Determination of the rate constant for acid catalyzed hydrolysis of ethylacetate.
9. Heterogeneous equilibrium (determination of partition coefficient of acetic acid in n-butanol and water mixture).
10. Conductometric titration for the determination of strength of a given HCl solution against a standard NaOH solution.
11. pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
12. Determination of chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

Course Title : Programming for Problem Solving Lab					
Course Code : CSE1051					
Contact hrs. per week:	L	T	P	Total	Credit points
	0	0	3	3	1.5

Course Outcomes:

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

CSE1051.1 write simple programs relating to arithmetic and logical problems.
CSE1051.2 interpret, understand and debug syntax errors reported by the compiler.
CSE1051.3 implement conditional branching, iteration (loops) and recursion.
CSE1051.4 decompose a problem into modules (functions) and amalgamating the modules to generate a complete program.
CSE1051.5 use arrays, pointers and structures effectively in writing programs.
CSE1051.6 create, read from and write into simple text files.

Software to be used: GNU C Compiler (GCC) with LINUX NB: Cygwin (Windows based) may be used in place of LINUX

Topic 1: LINUX commands and LINUX based editors

Topic 2: Basic Problem Solving

Topic 3: Control Statements (if, if-else, if-elseif-else, switch-case)

Topic 4: Loops - Part I (for, while, do-while)

Topic 5: Loops - Part II

Topic 6: One Dimensional Array

Topic 7: Array of Arrays

Topic 8: Character Arrays/ Strings Topic

Topic 9: Basics of C Functions

Topic 10: Recursive Functions

Topic 11: Pointers

Topic 12: Structures

Topic 13: File Handling

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

Course Title : Basic Electrical Engineering Lab					
Course Code : ELE1051					
Contact hrs. per week:	L	T	P	Total	Credit points
	0	0	2	2	1

Course Outcomes:

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

ELE1051.1 Get an exposure to common electrical apparatus and their ratings.

ELE1051.2 Make electrical connections by wires of appropriate ratings.

ELE1051.3 Understand the application of common electrical measuring instruments.

ELE1051.4 Understand the basic characteristics of different electrical machines.

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 Title : English for Technical Writing Lab					
Course Code : HUM1051					
Contact hrs. per week:	L	T	P	Total	Credit points
	0	0	2	2	1

Course Outcomes:

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

HUM1051.1 Communicate in an official and formal environment.
HUM1051.2 Effectively communicate in a group and engage in relevant discussion.
HUM1051.3 Engage in research and prepare presentations on selected topics.
HUM1051.4 Understand the dynamics of multicultural circumstances at workplace and act accordingly.
HUM1051.5 Organize content in an attempt to prepare official documents.
HUM1051.6 Appreciate the use of language to create beautiful expressions

Detailed Syllabus

Module- I (6L)

The Art of Speaking

- Techniques for Effective Speaking
- Voice Modulation: Developing correct tone
- Using correct stress patterns: word stress, primary stress, secondary stress. Rhythm in connected speech
- Encoding Meaning Using Nonverbal Symbols,
- How to Improve Body Language
- Eye Communication, Facial Expression, Dress and Appearance
- Posture and Movement, Gesture, Paralanguage
- Encoding meaning using Verbal symbols: How words work and how to use words
- Volume, Pace, Pitch and Pause
- Structuring content for delivery in accordance with time, platform, and audience.

Module- II (6L)

Group Discussion

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

Module- III (6L)

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

Module- IV (6L)

Professional Presentation Skills

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

References:

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

DETAILED SYLLABUS

2nd Year

SECOND YEAR
FIRST SEMESTER

Course Name: Data Structures & Algorithms					
Course Code:CSE2101					
Contact Hours per week:	L	T	P	Total	Credit points
	4	0	0	4	4

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

CSE2101.1. Understand and remember the basics of data structures and how time complexity analysis is applicable to different types of algorithms.
CSE2101.2. Understand the significance and utility of different data structures and the context of their application. (For example, the queue in front of ticket counters uses first-in-first-out paradigm in a linear data structure)
CSE2101.3. Apply different types of data structures in algorithms and understand how the data structures can be useful in those algorithms.
CSE2101.4. Analyse the behaviour of different data structures in algorithms. (For example, given an algorithm that uses a particular data structure, how to calculate its space and time complexity.)
CSE2101.5. Evaluate solutions of a problem with different data structures and thereby understand how to select suitable data structures for a solution. (For example, what are the different ways to find the second largest number from a list of integers and which solution is the best.)
CSE2101.6. Evaluate different types of solutions (e.g. sorting) to the same problem.

Detailed Syllabus
Module I [10L]

Introduction: Why do we need data structure? Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type; Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – Big O, Ω, Θ, notations.

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

Linked List: Singly linked list, circular linked list, doubly linked list, doubly circular linked list, linked list representation of polynomial and applications.

Module II [10L]

Stack and Queue: Stack and its implementations (using array, using linked list), applications. Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list), applications. Implementation of deque- with input and output restriction.
Recursion: Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle (Concept of Backtracking).

Module III [14L]

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

Graphs: Graph definitions and Basic concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut vertex/articulation point, complete graph, simple path, simple cycle). Graph representations/storage implementations – adjacency matrix, adjacency list, Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications of DFS – Topological Sort and Strongly-connected components.

Module IV [14L]

Sorting Algorithms: Bubble sort and its optimizations, Cocktail Shaker Sort, Insertion sort (Best-case, worst-case and Average-case analysis), Selection sort, Heap sort with Time-complexity analysis (concept of max heap, application – priority queue), Counting Sort.

Searching: Sequential search, Binary search (Worst-case and average-case analysis), and Interpolation search.

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

1. Textbooks

1. Fundamentals of Data Structures of C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
2. Data Structures in C, Aaron M. Tenenbaum.
3. Data Structures, S. Lipschutz.
4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

2. Reference Books

1. Data Structures and Program Design In C, 2/E, Robert L. Kruse, Bruce P. Leung.

Course Name: Python Programming					
Course Code: DSC2101					
Contact Hours per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes

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

DSC2101.1. Understand the basics of the Python Programming Language and its data structures viz. Lists, Tuples, Dictionaries and Sets

DSC2101.2. Develop Python codes using iterations, recursion, function, input/output with files and using exception handling.

DSC2101.3. Learn how to manipulate strings, use regular expression, object-oriented features of Python and also how to write good and efficient codes in Python.

DSC2101.4. Apply NumPy library and develop codes using Pandas data structures (Series and Data Frames) and other features of Pandas.

DSC2101.5. Learn GUI programming using Tkinter, Symbolic computing using SymPy, plotting and visualization using Matplotlib and Equation Solving, Optimization, Interpolation, Integration and solving Ordinary Differential Equation using SciPy..

DSC2101.6. Apply Python in building solutions to basic data analysis problems

Detailed Syllabus

Module I [8L]

Introduction to Python: History of Python. Setting up the development environment. Variables, Expressions, Statements. Functions, Conditionals, Recursion, Iteration.

Data Organization: Files and Exceptions. Classes, objects, inheritances, Object Oriented Programming in Python.

Module II [9L]

Manipulating Strings: Regular Expressions in Python.

Python Data Structures: Lists, Tuples, Dictionaries, Sets.

Effective Python: Pythonic Thinking and Writing Better Pythonic Code.

Module III [9L]

Processing with NumPy: The Basics of NumPy Arrays. Array Indexing: Accessing Single Elements. Array Slicing: Accessing Subarrays. Reshaping of Arrays. Array Concatenation and Splitting. Computation on NumPy Arrays: Universal Functions. The Slowness of Loops. Aggregations: Min, Max, Summing the Values in an Array.

Computation on Arrays: Broadcasting. Rules of Broadcasting. Comparisons, Masks, and Boolean Logic. Working with Boolean Arrays. Boolean Arrays as Masks. Fancy Indexing.

Data Manipulation with pandas: Introduction to pandas data structures. Series, Data frames, Index objects. Re-indexing, Selection, Filtering, Axis Indices, Summarizing, Handling missing data, Hierarchical Indexing.

Module IV [10L]

GUI Programming Using Tkinter

Getting Started with Tkinter, Processing Events, The Widget Classes, Canvas widget for displaying shapes, Geometry Managers, Displaying Images, Menus, Popup Menus, Mouse, Key Events, and Bindings, Animations, Scrollbars, Standard Dialog Boxes.

Symbolic Computing using SymPy

Plotting and Visualization using Matplotlib

Using SciPy: Equation Solving, optimization, interpolation, integration, Ordinary differential equation

Textbooks

1. Introduction to Programming Using Python, Y. Daniel Liang. Pearson, 2017.
2. Introduction to Python for Engineers and Scientists, Sandeep Nagar, Apress, 2018
3. Python for Data Analysis, Wes McKinney, O'Reilly, 2017.
4. Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib Book by Robert Johansson, Apress, 2019

Reference Books

1. Python for Everybody, Charles Severance, 2016.
2. Effective Python, Brett Slatkin, Pearson, 2015.
3. Learn Python The Hard Way, Zed A. Shaw, Addison-Wesley, Third Edition

Paper Name: Data Mining					
Paper Code: AML2101					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes

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

AML2101.1 Remember different terminologies in respect of data mining techniques.

AML2101.2 Understand and apply the various data pre-processing, data transformation, data reduction methods as and when required.

AML2101.3 Understand and apply different classification, clustering algorithms to solve various real life problems.

AML2101.4 Analyze various methods for mining the frequent patterns in different real life situations.

AML2101.5 Apply several ensemble techniques, like bagging, boosting, random forests etc. as and when required.

AML2101.6 Evaluate various data mining techniques to solve real-world problems.

Detailed Syllabus

Module 1 [9L]

Introduction: Basics of Data Mining. Why do we need data mining? Getting to know your data: Data Visualization

Data pre-processing: Data cleaning, Data transformation and Data reduction

Association Rule Mining: Rules and Frequent item-set generation, Apriori algorithm - candidate generation and pruning, FP- growth algorithm.

Module 2 [9L]

Supervised Classification Techniques: Bayesian Network: Bayes theorem, Naïve Bayes and Gaussian Naive Bayes classifier.

k - nearest neighbor (k-NN) classifier.

Decision Tree: using Gini index, Information gain.

Classification performance evaluation metrics – accuracy, precision, recall, F1-measure etc.

Module 3 [9L]

Ensemble Methods: Bagging, Boosting, Random Forests

Brief Introduction to simple ANN Model, Input, Output and Hidden layers, Activation functions.

Numeric prediction, Simple Linear Regression model, Outline of logistic regression.

Module 4 [9L]

Cluster Analysis: Introduction: Motivations, objectives and applications of clustering. Different types of clustering. Partitional Clustering: K-means, K-medoid, Hierarchical Clustering: Agglomerative, Divisive, MIN, MAX, dendrogram representation.

Density-based Clustering: DBSCAN. Cluster evaluation, further reading – OPTICS, DENCLUE, CHAMELEON, BIRCH, CURE, ROCK.

Textbooks

1. Data Mining Concepts and Techniques, 3rd, Edition, J. Han and M. Kamber, Morgan Kaufmann Publishers, July 2011.

Reference Books

1. Introduction to Data Mining, P. N. Tan, M. Steinbach and V. Kumar, Pearson Publishers.

2. Pattern Recognition and Machine Learning, Third Edition, C. Bishop, Springer, 2006.

Course Name: Probability and Statistical Methods					
Course Code:MTH2102					
Contact Hours per week:	L	T	P	Total	Credit points
	4	0	0	4	4

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

MTH2102.1. Compare and contrast different interpretations of probability theory and take a stance on which might be preferred.
MTH2102.2. Formulate predictive models to tackle situations where deterministic algorithms are intractable.
MTH2102.3. Understand the application of probability and statistics in different real-world problems.
MTH2102.4. Summarize data visually and numerically.
MTH2102.5. Assess data-based models.
MTH2102.6. Apply tools of formal inference.

Detailed Syllabus
Module I [10L]

Probability-I (Probability distributions): Special type of distribution: Binomial distribution, Normal distribution, Binomial approximation to Normal distribution, Poisson distribution, Exponential distribution; Moment generating and characteristic functions, Limit theorems: Markov's inequality and Chebyshev's inequality.

Module II [10L]
Joint distribution: Joint distribution using joint probability mass/density function, finding Marginal pmf/pdf from joint distribution, Multiplicative property of joint pmf/ pdf in case of independent random variables.
Markov Chains: Markov Chains: Introduction, Chapman-Kolmogorov equations, Classification Of states, Some applications.

Module III [10L]

Statistics-I: Measure of central tendency: Mean, Median, Mode; Measure of dispersion: Quartile Deviation, Standard Deviation; Moments, Skewness and Kurtosis; Covariance, Correlation and Regression, Spearman's Rank Correlation coefficient; Curve fitting: Straight line and parabolas.

Module IV [10L]

Statistics-II: Population and Samples, The sampling distribution of mean (standard deviation known),The sampling distribution of mean (standard deviation unknown), Point and Interval estimation, Tests of Hypotheses, Null Hypotheses and Tests of Hypotheses.

Textbooks

1. Introduction to Probability and Statistics for Engineers and Scientists, S.M. Ross, Elsevier.
2. Groundwork of Mathematical Probability and Statistics, Amritava Gupta, Academic Publishers.
3. Probability, Statistics and Random Processes, T. Veerarajan, Tata McGraw-Hill Publishing Company Limited.

Reference Books

1. Probability and Statistics for Engineers, Richard A Johnson, Pearson Education
2. An Introduction to Probability theory and its applications Vol-I, W. Feller, John Wiley and Sons
3. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand and Sons.

Course Name: Discrete Mathematics					
Course Code: MTH2103					
Contact Hours per week:	L	T	P	Total	Credit points
	4	0	0	4	4

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

MTH2103.1. Interpret the problems that can be formulated in terms of graphs and trees.

MTH2103.2. Explain network phenomena by using the concepts of connectivity, independent sets, cliques, matching, graph coloring etc.
MTH2103.3. Achieve the ability to think and reason abstract mathematical definitions and ideas relating to integers through concepts of well-ordering principle, division algorithm, greatest common divisors and congruence.
MTH2103.4. Apply counting techniques and the crucial concept of recurrence to comprehend the combinatorial aspects of algorithms.
MTH2103.5. Analyze the logical fundamentals of basic computational concepts.
MTH2103.6. Compare the notions of converse, contrapositive, inverse etc. in order to consolidate the comprehension of the logical subtleties involved in computational mathematics.

Detailed Syllabus
Module I [10L]

Graph Theory: Tree, Binary Tree, Spanning Tree. Walk, Path, Cycle, Hamiltonian Graph, The Travelling Salesman Problem, Euler Graph, The Chinese Postman Problem. Planar Graph, Euler's Formula for Planar Graph and Related Problems. Examples of Non-Planar Graphs. Kuratowski's Theorem. Matching, Hall's Marriage Theorem and Related Problems. Vertex Colouring.

Module II [10L]
Number Theory: Well Ordering Principle, Principle of Mathematical Induction, Divisibility theory and properties of divisibility, Fundamental Theorem of Arithmetic, Euclidean Algorithm for finding greatest common divisor (GCD) and some basic properties of GCD with simple examples, Congruence and its properties, Residue classes of integer modulo n ($\mathbb{Z}$)and its examples, Fermat's Theorem, Wilson's Theorem and Chinese Remainder Theorem.

Module III [10L]
Combinatorics: Counting Techniques: Permutations and Combinations, Distinguishable and Indistinguishable Objects, Binomial Coefficients, Generation of Permutations and Combinations, Pigeon-hole Principle, Generalized Pigeon-Hole Principle, Principle of Inclusion and Exclusion,

Generating Functions and Recurrence Relations: Solving Recurrence Relations using Generating Functions and other Methods.

Module IV [10L]

Propositional Calculus: Propositions, Logical Connectives, Truth Tables, Conjunction, Disjunction, Negation, Implication, Converse, Contra positive, Inverse, Bi-conditional Statements, Logical Equivalence, Tautology, Normal Forms, CNF and DNF, Predicates, Universal and Existential Quantifiers, Bound and Free Variables, Examples of Propositions with Quantifiers.

Textbooks

1. T. Veerarajan, Discrete Mathematics, McGraw Hill Education.
2. J. L. Mott, A. Kandel and T. P. Baker, Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall.
3. David M. Burton, Elementary Number Theory, McGraw Hill Education.
4. Introduction to Graph Theory (2nd Ed), D G West, Prentice-Hall of India, 2006.

Reference Books

1. Beginning Number Theory, Neville Robbins, Narosa Publishing House
2. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw- Hill
3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics: A Computer Oriented Approach, Tata McGraw Hill
4. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It's Application to Computer Science, Tata McGraw Hill
5. Norman L. Biggs, Discrete Mathematics, Oxford University Press, Schaum's Outlines Series, Seymour Lipschutz, Marc Lipson
6. S.K. Mapa, Higher Algebra (Classical), Sarat Book Distributors

Course Name: Data Structures& Algorithms Lab					
Course Code:CSE2151					
Contact Hours per week:	L	T	P	Total	Credit points
	0	0	3	3	1.5

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

CSE2151.1. To understand linear and non-linear data structures.
CSE2151.2. To understand different types of sorting and searching techniques.
CSE2151.3. To know how to create an application specific data structure.
CSE2151.4. To solve the faults / errors that may appear due to wrong choice of data structure.
CSE2151.5. To analyse reliability of different data structures in solving different problems.
CSE2151.6. To evaluate efficiency in terms of time and space complexity, when different data structures are used to solve same problem.

Detailed Syllabus
Day 1: Time and Space Complexity

Lab Assignment

Create three different 10; 000 10; 000 matrices matrixOne, matrixTwo and result-Matrix, using dynamic memory allocation. Initialize matrixOne and matrixTwo by using rand() or srand() function, limit the values from 0 to 9. Multiply matrixOne and matrixTwo into resultMatrix.

While execution, open another terminal and use top command to see the usage of memory by the process. Calculate the time taken for the execution of the program.

Repeat the same exercise for 100,000 x 100,000matrices.

Home Assignment

Write a program (WAP) to check whether a matrix is i) identity, ii) diagonal. WAP to reverse the elements of an array without using any other variable.

Day 2: Array

Lab Assignment

WAP to add two polynomials using array. Minimize the memory usage as much as you can.
WAP to convert a matrix into its sparse representation (triple format). Once represented in sparse format, do not revert back to the matrix format any-more. Manipulate the sparse representation to find the transpose of the matrix (which should also be in sparse representation).
Calculate and find out whether using triple format for your example is advantageous or not.

Home Assignment

WAP to multiply two polynomials. Minimize usage of memory.

WAP to add two matrices using sparse representation. Manipulation of data should be done in sparse format.

Day 3: Singly Linked List

Lab Assignment

Write a menu driven program to implement a singly linked list with the operations:

i) create the list ii) insert any element in any given position (front, end or intermediate)
iii) delete an element from any given position (front, end or intermediate) iv)display the list

Home Assignment

Write a menu driven program to implement a singly linked list with the operations:

i) count the number of nodes
ii) reverse the list

Day 4: Circular and Doubly Linked List

Lab Assignment

Write a menu driven program to implement a circular linked list with the operations:

i) create the list ii) insert any element in any given position (front, end or intermediate)
iii) delete an element from any given position (front, end or intermediate) iv)display the list

Home Assignment

Write a menu driven program to implement a doubly linked list with the operations:

i) create the list ii) insert any element in any given position (front, end or intermediate)
iii) delete an element from any given position (front, end or intermediate) iv)display the list

Day 5: Stack, Queue - with array

Lab Assignment

Write a menu driven program to implement stack, using array, with

i) push, ii) pop, iii) display, iv) exit operations.

WAP to evaluate a postfix expression.

Write a menu driven program to implement a queue, using array, with

i) insert, ii) delete, iii) display, iv) exit operations

Home Assignment

WAP to convert an infix expression to its corresponding postfix operation.

Write a menu driven program to implement a double-ended queue, using array, with the following operations:

i) insert (from front, from rear) ii) delete (from front, from rear)
iii) display iv) exit operations

Day 6: Stack, Queue - with linked list

Lab Assignment

Write a menu driven program to implement a stack, using linked list, with

i) push, ii) pop, iii) exit operations

Home Assignment

Write a menu driven program to implement a queue, using linked list, with

i) insert, ii) delete, iii) exit operations

Day 7: Circular Queue, Deque - with linked list

Lab Assignment

Write a menu driven program to implement a circular queue using linked list with

i) insert, ii) delete, iii) exit operations

Home Assignment

Write a menu driven program to implement a double-ended queue, using linked list, with the following operations:

i) insert (from front, rear), ii) delete (from front, rear), iii) exit operations

Day 8: Binary Search Tree (BST)

Lab Assignment

Write a program, which creates a binary search tree (BST). Also write the functions to insert, delete (all possible cases) and search elements from a BST.

Home Assignment

Write three functions to traverse a given BST in the following orders:

i) in-order, ii) pre-order, iii) post-order.

Display the elements while traversing.

Day 9: Searching

Lab Assignment

WAP to implement,

i) Linear Search, ii) Binary Search (iterative)

NB: As a pre-processing step, use bubble-sort to sort the elements in the search space.

WAP to generate integers from 1 to n (input parameter) in random order and guarantees that no number appears twice in the list. While the number sequence is being generated, store it in a text file.

Home Assignment

WAP to implement binary search recursively.

Day 10: Sorting

Lab Assignment

Write different functions for implementing,

i) Bubble sort, ii) Cocktail shaker sort, iii) Quick Sort.
Plot a graph of n vs. time taken, for n= 100, 1000, 10,000 and 100,000 to com-pare the performances of the sorting methods mentioned above. Use the second assignment of Day 9 to generate the data, using the given n values.

Home Assignment

Write different functions for implementing,

i) Insertion sort, ii) Merge sort.

Day 11: Graph Algorithms

Lab Assignment

Read a graph (consider it to be undirected) from an edge-list and store it in an adjacency list.

Use the adjacency list to run DFS algorithm on the graph and print the node labels. Detect and count the back-edges.

Home Assignment

WAP to implement BFS algorithm of a given graph (similarly as described for DFS, instead of back-edges count cross-edges)**.**

Textbooks

1. Fundamentals of Data Structures of C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
2. Data Structures in C, Aaron M. Tenenbaum.
3. Data Structures, S. Lipschutz.
4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

Reference Books

Data Structures and Program Design In C, 2/E, Robert L. Kruse, Bruce P. Leung.

Course Name: Python Programming Lab					
Course Code:DSC2151					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Course Outcomes

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

DSC2151.1. Learn how to write simple programs in Python, relating to arithmetic and logical problems.

DSC2151.2. Understand how to implement conditional branching, iteration (loops), recursion and function.

DSC2151.3. Develop python codes to do input/output with files in Python and use exception handling.

DSC2151.4. Learn and understand how to manipulate strings, use regular expression, and also use Python data structures viz. Lists, Tuples, Dictionaries and Sets.

DSC2151.5. Apply NumPy Arrays in solving problems.

DSC2151.6. Design and develop codes using Pandas data structures (Series, Data Frames) and other features of Pandas.

Detailed Syllabus:

Topic 1:

(a) Finding the distance between two points whose coordinates are given
(b) Finding the impedance of a series R-L-C Circuit
(c) Finding the roots of a quadratic equation
(d) Finding the maximum and minimum out of a few numbers given
(e) Finding the value of sine of a given angle from its series expansion
(f) Finding the Time period of a pendulum, whose length varies from 100 to 120 cm in steps of 5 cm.

Topic 2:

Implement programs using functions:

a. Largest number in a list
b. Area of different shapes
c. Circulate the values of n variables
d. Distance between two points whose coordinates are given
e. Roots of a quadratic equation
f. Factorial
g. Fibonacci series
h. GCD

Topic 3:

Implement programs on File I/O and exception handling:

a. Copying a file
    1. Take source file name and destination file name from the user
    2. Use exception handling to report error, if any
    3. Copy thesource text file to the destination.
    4. Report completion status, number of characters copied etc. to the user
b. Finding word count and longest word in a file
c. Use exception handling in nested functions
d. Write a program to show positive use of exception handling

Topic 4:

(a) Write programs to use various in-built functions of Python on string manipulation (reverse, palindrome, character count, replacing characters)
(b) Write programs to show the use of regular expression
(c) Write programs using Python data structures viz. Lists, Tuples, Dictionaries and Sets

Topic 5:

Write programs using various features provided in the NumPy

Topic 6:

Write programs using Pandas data structures and various features provided in Pandas

Text Books:

1. Allen B. Downey, Think Python: How to think like a Computer Scientist, 2nd Edition, O'Reilly, 2016
2. Y. Daniel Liang, Introduction to Programming Using Python, Pearson, 2017

Reference Books:

1. Karl Beecher, Computational Thinking: A Beginners Guide to Problem Solving and Programming, 1st Edition, BCS Learning and Development Limited, 2017

Paper Name: Data Mining Lab					
Paper Code: AML2151					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**1.5**

Course Outcomes

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

AML2151.1 Understand the errors and noises present in data and apply various techniques to clean them.

AML2151.2 Learn, implement and compare various classification algorithms

AML2151.3 Learn, implement and compare various clustering algorithms

AML2151.4 Understand and implement a-priori and FP-tree algorithms for association rule mining

AML2151.5 Analyze the problem (data) and use appropriate algorithm to data mining problems

AML2151.6 Apply data mining algorithms on real-world data

Detailed Syllabus

1. Familiarization with
    (i) R Studio

2. Preprocessing of Data
    (i) Data set generation
    (ii) Identification and cleaning of data
    (iii) Noise removal from data

3. Linear Regression
4. Classifiers
    (i) K-NN
    (ii) Naïve Bayes Classifier
    (iii) Decision Tree
5. Clustering Algorithms
    (i) K-Means
    (ii) DB-Scan
    (iii) Hierarchical Clustering

Textbooks

1. Data Mining Concepts and Techniques, 3rd, Edition, J. Han and M. Kamber, Morgan Kaufmann Publishers, July 2011.
2. Python for Data Analysis, Wes McKinney, O'Reilly, 2017.

Reference Books

1. Introduction to Data Mining, P. N. Tan, M. Steinbach and V. Kumar, Pearson Publishers.

Paper Name: Design Thinking and Idea Lab (CSE (AI & ML))					
Paper Code: AML2155					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course Outcomes

AML2155.1: Understand the definition, objectives, and relevance of design thinking.

AML2155.2: Get familiarized with the stages of the design process: Empathize, Define, Ideate, Prototype, and Test.

AML2155.3: Learn how to apply the design thinking process for developing innovative products.

AML2155.4: Propose innovative product designs and choose appropriate frameworks, strategies, and techniques during prototype development.

AML2155.5: Perceive individual differences in user perspectives and offer appropriate interventions towards enhanced user experience.

Detailed Syllabus (in-depth discussion of these topics is available in the text book suggested below):

1. Design thinking is a way of thinking
    a. The fundamental attitude of design thinking
    b. Think flexibly
    c. Work integrally
    d. Empathize
    e. Cooperate
    f. Imagine
    g. Experiment
2. Design thinking is a way of working
    a. The cycle of design thinking
    b. The design process
    c. Discovery phase: Loving the problem
    d. Definition phase: Defining the problem
    e. Development phase: Working on solutions
    f. Implementation phase: Towards functioning solutions in practice
    g. Using design thinking as a business strategy
3. Design thinking is a project approach
    a. Discovery phase: From cause to insight
    b. Definition phase: From insight to problem definition and solution area
    c. Development phase: From solution area to solutions
    d. Implementation phase: Putting solutions into practice
    e. Other roadmaps

4. Design thinking is a tool box
    a. Assumption busting
    b. Business model canvas
    c. Decision matrix
    d. Empathy map
    e. One-hour prototype
    f. Personas
    g. Scenarios
    h. Stakeholder map
    i. Storyboard
    j. User diaries
    Etc.

Note: In the lab sessions, students will be working in teams to develop working prototypes using design thinking principles. A prototype can either be software or hardware based, or a combination of both. A set of slides, a document, a spreadsheet, or a user interface mock up will not qualify as a prototype. Students will need to make at least one presentation (with the idea of the prototype), and one demonstration (with the functioning prototype) during the semester. Continuous and end-semester assessment of student performance will be based on established evaluation rubrics.

Text book

Den Dekker Teun, "Design Thinking", Wolters-Noordh off B.V., Dec, 2020

Reference books

1. Prof. Karl Ulrich, U. Penn, "Design: Creation of Artifacts in Society by Change", Oct, 2012
2. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Kindle edition, 2009.
3. Pavan Soni, "Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving", Penguin Random House India Private Limited, 23 December 2020.

SECOND YEAR
SECOND SEMESTER

Course Name: Design & Analysis of Algorithms					
Course Code:CSE2201					
Contact Hours per week:	L	T	P	Total	Credit points
	4	0	0	4	4

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

CSE2201.1. Remember time complexities of various existing algorithms in different situations.
CSE2201.2. Understand the basic principles of different paradigms of designing algorithms.
CSE2201.3. Apply mathematical principles to solve various problems.
CSE2201.4. Analyze the complexities of various algorithms in worst case, best case and average case.
CSE2201.5. Assess the computational hardness of a problem and learn how some of the well-known problems are proved to be NP-hard and also design approximation algorithms for some of them.
CSE2201.6. Create/ Design a good algorithm for a new problem given to him/ her.

Detailed Syllabus
Module I [12L]

Algorithm Analysis: Time and space complexity. Asymptotic Notations and their significance. Asymptotic Analysis. Finding time complexity of well-known algorithms. Asymptotic solution to recurrences, Substitution Method, Recursion Tree, Master Theorem.

Divide-and-Conquer Method: Basic Principle, Binary Search (revision), Merge Sort – Time Complexity Analysis, quicksort – Worst-case and Average Case Analysis, Concept of Randomized Quicksort.

Lower Bound Theory: Lower bound of comparison sort.

Medians and Order Statistics – Randomized Linear Time algorithm only (Deterministic algorithm excluded)

Module II [12L]
Greedy Method: Elements of the greedy strategy. Fractional Knapsack Problem, Huffman codes.
Graph Algorithms: Minimum cost spanning trees: Prim's and Kruskal's algorithms and their correctness proofs (Greedy Method). Shortest Path Algorithm: Dijkstra's with correctness proof. (Greedy method), Bellman Ford with correctness proof.
Amortized Analysis: Aggregate method.

Module III [12L]

Dynamic Programming: Basic method, use, Examples: 0-1 Knapsack Problem, Matrix-chain multiplication, LCS Problem, All pair shortest path (Floyd-Warshall Algorithm).

String matching algorithms: Different techniques – Naive algorithm, string matching using finite automata, and Knuth, Morris , Pratt (KMP) algorithm with their complexities

Randomized Algorithm: Skip List.

Module IV [12L]

Disjoint Set Manipulation: UNION-FIND with union by rank, Path compression.

Network Flow: Ford Fulkerson algorithm, Max - Flow Min - Cut theorem (Statement and Illustration only without proof)

NP-completeness: P class, NP-hard class, NP-complete class. Relative hardness of problems and polynomial time reductions. Satisfiability problem - Cook-Levin Theorem (Statement only without proof). Reduction of 3-SAT to Clique Decision Problem, Equivalence of Vertex Cover Problem, Independent Sets and Clique Decision Problem.

Approximation algorithms: Necessity of approximation algorithm, performance guarantee, Approximation scheme (AS), Polynomial type approximation scheme (PTAS), and Fully polynomial time approximation scheme (FPTAS)(only definition and illustration, no algorithm). 2-approximation algorithm for vertex cover and its correctness proof.

Textbooks

1. Introduction to Algorithms by Cormen, Leiserson, Rivest and Stein. Third Edition, 2009. Prentice Hall.
2. Algorithm Design by Jon Kleinberg and Eva Tardos. Addison Wesley, 2005.

Reference Books

1. Computer Algorithms: Introduction to Design and Analysis by Sarah Basee and Allen van Gelder. 3rd Edition, Addison Wesley.

Course Name: Computer Organization and Architecture					
Course Code:CSE2202					
Contact Hours per week:	L	T	P	Total	Credit points
	4	0	0	4	4

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

CSE2202.1. Understand the basic organization of computer and different instruction formats and addressing modes.
CSE2202.2. Analyze the concept of pipelining, segment registers and pin diagram of CPU.
CSE2202.3. Understand and analyze various issues related to memory hierarchy.
CSE2202.4. Understand various modes of data transfer between CPU and I/O devices.
CSE2202.5. Examine various inter connection structures of multi-processor.
CSE2202.6. Design architecture with all the required properties to solve state-of-the-art problems.

Detailed Syllabus

Module I [10L]

Basics of Computer Organization: Basic organization of the stored program computer and operation sequence for execution of a program, Von Neumann & Harvard Architecture. RISC vs. CISC based architecture.

Fetch, decode and execute cycle, Concept of registers and storage, Instruction format, Instruction sets and addressing modes.

Basics of Control Unit Design - hardwired and micro programmed control, Horizontal and Vertical micro instruction.

Module II [11L]

Memory and I/O Organization: Memory system overview, Cache memory organizations, Techniques for reducing cache misses, Hierarchical memory technology: Inclusion, Coherence and locality properties, Virtual Memory, Memory mapped IO.

Introduction to I/O interfaces. Interrupts, Interrupt hardware, Enabling and Disabling interrupts, Concept of handshaking, Polled I/O, Priorities, Daisy Chaining. Vectored interrupts; Direct memory access, DMA control.

Module III [10L]

Pipelined Architecture: Brief Introduction, Performance Measures - speed up, Efficiency, performance - cost ratio etc.

Static pipelines - reservation tables, scheduling of static pipelines, definitions - minimum average latency, minimum achievable latency, greedy strategy etc. Theoretical results on latency bounds without proof.

Vector Processing: Vector registers; Vector Functional Units; Vector Load / Store; Vectorization; Vector operations: gather / scatter; Masking; Vector chaining.

Module IV [9L]

SIMD Architectures: Brief introduction, various concepts illustrated by studying detailed SIMD algorithms, viz., Matrix multiplication, Sorting on Linear array.

Interconnection Networks: Detailed study of Interconnection Network - Boolean cube, Mesh, Shuffle-exchange, Banyan, Omega, Butterfly, Generalized Hypercube, Delta etc.

Textbooks

1. Computer Organization, 5th Edition, Carl Hamacher, ZvonkoVranesic, SafwatZaky, MGH.
2. Computer System Architecture, 3rd Edition, Morris M. Mano, Pearson.
3. Computer Organization and Design: The Hardware/Software interface, David A. Patterson and John L. Hennessy, 3rd Edition, Elsevier, 2005.
4. Advanced Computer Architecture and Parallel processing, Hwang & Briggs, MH.
5. Advanced Computer Architecture: Parallelism, Scalability, Programmability, Kai Hwang, McGraw-Hill.

Reference Books

1. Onur Mutlu's lecture materials on Computer Architecture from CMU web site: https://users.ece.cmu.edu/~omutlu/.
2. NPTEL materials on Computer Organization.

Paper Name: Introduction to Artificial Intelligence					
Paper Code: AML2201					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course Outcomes:

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

AML2201.1. Remember and understand the basic principles of state-space representation of any given problem, various searching and learning algorithms, game playing techniques, logic theorem proving etc.

AML2201.2. Comprehend the importance of knowledge as far as intelligence is concerned and the fundamentals of knowledge representation and inference techniques.

AML2201.3. Apply this knowledge so that it can be used to infer new knowledge in both certain and uncertain environment

AML2201.4. Apply various AI searching algorithms, like state-space search algorithm, adversarial search algorithm, constraint satisfaction search algorithm as and when required.

AML2201.5. Understand the working knowledge of Prolog/ Lisp in order to write simple Prolog/ Lisp programs and explore more sophisticated Prolog/ Lisp code on their own.

AML2201.6. Design and evaluate the performance of a heuristic applied to a real-world situation.

Detailed Syllabus

Module I [12L]

Introduction: Definition of AI, Intelligent Behaviour, Turing Test, Typical AI Problems, Various AI Approaches, Limits of AI; Introduction to Agents & environment, Agent Architecture, Agent Performance, Rational Agent, Nature of Environment, Simple Reflex Agent, Goal Based Agent, Utility Based Agent.

Problem Solving using Single Agent Search: Introduction to State-space search, state-space search notation, search problem, Formulation of some classical AI problems as a state space search problem.

Uninformed Search Techniques: Basic Principles, Evaluating parameters, BFS, DFS, Depth Limited Search, Iterative Deepening DFS, Uniform Cost Search & Bidirectional Search, Properties of various search methods & their comparative studies.

Informed Search Methods: Basic Principles, Heuristics, A* Search and its properties, Admissible & Consistent heuristic, Iterative deepening A* (IDA*) and AO* search

Module II [12L]

Problem Solving using Two Agent Search: Adversarial Search – Game Tree, MINIMAX Algorithm, Alpha-Beta Pruning, Performance Analysis.

Local Search Techniques: Hill climbing & Simulated Annealing, Comparison with other search methods.

Constraint Satisfaction Problem: Definition of CSP, Representation of CSP, Formulation of Various popular problems as CSP, Solution methods of CSP – Backtracking & Forward Checking.

Planning: Introduction, Simple planning agent, Problem solving vs. planning, Logic based planning, Goal Stack planning, Planning as a search, Total-order vs. partial order planning.

Module III [12L]

Knowledge Representation & Propositional Logic: Knowledge representation issues, Approaches to knowledge representation, Propositional Logic – its syntax & semantics, Inference rules, Resolution for propositions, Limitation of Propositional Logic.

Knowledge Representation & Predicate Logic: Syntax & Semantics of FOPL, Representation of facts using FOPL, Clauses, Resolution, Unification methods of inference.

Knowledge Representation using Rules: Rule based system, Horn clauses, Procedural vs. declarative knowledge, Introduction of logic programming using PROLOG/ LISP.

Reasoning in uncertain domain: Representing knowledge in an uncertain domain, probabilistic inference rules, Bayesian networks – representation & syntax, semantics of Bayesian net, Brief discussion on Fuzzy sets & fuzzy logic.

Module IV [12L]

Learning: Overview, Taxonomy of learning system, various learning models, learning rules, Naïve Bayes classifier and Decision tree based learning, brief idea about learning using Neural Network & Genetic Algorithm.

Natural Language Processing: Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.

Expert Systems: Representing and using domain knowledge, expert system shells, and knowledge acquisition.

Text Books

1. Artificial Intelligence: A Modern Approach, Stuart Russell & Peter Norvig, Pearson Education.
2. Artificial Intelligence, Rich & Knight, TMH.

Reference Books

1. Artificial Intelligence & Intelligent Systems, N.P Padhy, Oxford University Press.
2. Introduction to Artificial Intelligence & Expert Systems, Dan W. Patterson, PHI.

Paper Name: Digital Circuit Design					
Paper Code: ECE2002					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course Outcomes

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

ECE2002.1: Students will learn about the Binary Number system and minimization of logic expression using different methods.

ECE2002.2: Students will design different Arithmetic Combinational circuits like Adder, Subtractor.

ECE2002.3: Students will be able to design Multiplexer, De-Multiplexer, Decoder, Encoder, etc and learn about applications

ECE2002.4: Students will be able to design Sequential Circuits such as flip flops and perform inter conversion of them.

ECE2002.5: Students will design various types of Registers and Counters Circuits using Flip-Flops (Synchronous, Asynchronous, Irregular, Cascaded, Ring, Johnson).

ECE2002.6: Students will learn basic gates using CMOS logic and analyze different memory systems including RAM, ROM, EPROM, EEROM, etc.

Module I: [8L]

Data and number systems; Binary, Octal, and Hexadecimal representation and their conversions; BCD, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic. Boolean algebra, De-Morgan's theorem, Various Logic gates-their truth tables and circuits; Representation in SOP and POSforms; Minimization of logic expressions by algebraic method; Karnaugh-map method, Quine-McCluskey method (3 & 4 variables).

Module II:[12L]

Arithmetic Circuits: Adder circuit – Ripple Carry and BCD Adder; Subtractor circuit. Combinational Circuit: Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and parity Generator; Shannon's Expansion Theorem.

Module III: [10L]

Sequential Circuits- Sequential circuits design methodology; Basic memory element S-R, J-K, D, and T Flip Flops, Inter conversions of Flip-Flop; Finite State Machine Design using Sequential circuit design methodology; various types of Registers (with Parallel load, shift Registers), and Counters (Asynchronous ripple counters, Synchronous counters: BCD, Ring, Johnson).

Module IV: [8L]

Memory Systems: Concepts and basic designs of RAM, ROM, EPROM, EEROM, Programming logic devices and gate arrays (PLAs and PLDs) MOS as digital switch, basic working principle of nMOS, pMOS, CMOS inverter and realization of combinational circuit using CMOS logic.

Textbooks:

1. S.Salivahanan, S.Arivazhagan-Digital Circuit & Design, Oxford
2. Anandkumar-Fundamental of Digital Circuits, PHI
3. Virendra Kumar-Digital technology, New Age Publication
4. R.P.Jain-Modern Digital Electronics, 2/e, Mc Graw Hill

References:

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

Course Name: Introduction to Smart Sensing Technology for AI					
Course Code: AEI2206					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes

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

AEI2206.1. Apply the resistive potentiometer, strain gauge and capacitive transducers for the measurement of displacement, force, pressure etc. with suitable signal conditioning circuit.

AEI2206.2. Develop appropriate measurement scheme by LVDT and piezoelectric transducer.

AEI2206.3. Describe the methods of measurement by ultrasonic transducers and Hall sensor.

AEI2206.4. Implement the temperature measurement schemes by thermocouple, RTD and thermistor with appropriate signal conditioning circuit.

AEI2206.5. Construct the suitable measurement scheme by different optical sensors.

AEI2206.6. Understand the architecture of smart sensors, sensor network and the working principle of MEMS capacitive and piezoelectric sensors.

Module I [10L]

Introduction to different types of data to be used in artificial intelligence, sources of raw data, sensing and transduction principles, block diagram representation of a generalized measuring system, importance of signal conditioning unit, classification of transducers. Resistive type transducers – Resistive potentiometer, material, types, loading effect, sensitivity, resolution, applications; Strain gauges – working principle, material, types, gauge factor, quarter bridge, half bridge and full bridge configurations, temperature compensation methods, load cell, applications. Capacitive Transducer –working principle, arrangement for small displacement measurement, large displacement measurement, angular displacement measurement, push – pull type, cylindrical type, capacitive microphone.

Module II [8L]

Inductive Transducer – Linear variable differential transformer, schematic diagram, measurement of displacement, force and pressure. Piezoelectric Transducer – material, working principle, measurement of displacement, force and pressure. Ultrasonic Transducers - measurement of flow and level. Hall Sensor – working principle, measurement of magnetic field and other applications.

Module III [10L]

Temperature Sensors – Thermocouple, Seebeck and Peltier effect, Thermoelectric laws, working principle, types, cold junction compensation, signal conditioning circuit; Resistance Temperature Detector (RTD) –working principle, 3 wire and 4 wire connection of RTD, signal conditioning

circuit; Thermistor – working principle, types, signal conditioning circuit. Optical Sensors – Light dependent resistor (LDR), photovoltaic cell, photodiode, applications.

Module IV [8L]

Smart Sensors - architecture, features, applications; Intelligent sensors – architecture, features, applications; smart transmitters, sensor network; MEMS – introduction, components, fabrication basics, sensing principles of MEMS – piezo resistive, capacitive, piezoelectric, magnetic; MEMS applications - accelerometer, gyroscope, magnetometer.

References:

1. E. A. Doeblin, *Measurement Systems: Application and Design*, McGraw Hill, New York. Education Inc., NewDelhi,India.
2. D.V.S Murty, *Transducer and instrumentation, PHI, second edition, 2008.*
3. D. Patranabis, *Sensors and Transducers*, *PHI, second edition.*
4. J. P. Bentley, *Principle of Measurement Systems*, 3rd Edition, Pearson Education.

Course Name: Environmental Sciences (Mandatory)					
Course Code:EVS2016					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**0**

Course Outcomes

After completion of the course, students will be able to

EVS2016.1: Understand the natural environment and its relationships with human activities.
EVS2016.2: Characterize and analyze human impacts on the environment.
EVS2016.3: Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
EVS2016.4: Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.
EVS2016.5: Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.
EVS2016.6: Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Module I: [6L]

Socio Environmental Impact: Basic ideas of environment and its component
Population growth: exponential and logistic; resources; sustainable development.
Concept of green chemistry: green catalyst, green solvents
Environmental disaster and social issue: environmental impact assessment, environmental audit, environmental laws and protection act of India.

Module II: [6L]

Air Pollution: Structures of the atmosphere, global temperature models, Greenhouse effect, global warming; acid rain: causes, effects and control. Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution.

Module III: [6L]

Water Pollution: Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts. Biochemical effects of heavy metals; eutrophication: source, effect and control. Water quality parameters: DO, BOD, COD. Water treatment: surface water and wastewater.

Module IV: [6L]

Land Pollution: Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal.
Noise Pollution: Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noise threshold limit value; noise pollution effects and control.

Textbooks

1. Basic Environmental Engineering and Elementary Biology, GourKrishna Das Mahapatra, Vikas Publishing House P. Ltd.
2. Environmental Chemistry, A. K. De, New Age International.
3. Environmental Chemistry with Green Chemistry, A. K. Das, Books and Allied P. Ltd.

Reference Books

1. Environmental Science, S. C. Santra, New Central Book Agency P. Ltd.
2. Fundamentals of Environment & Ecology, D. De, D. De, S. Chand & Company Ltd.

Course Name: Design & Analysis of Algorithms Lab					
Course Code:CSE2251					
Contact Hours per week:	L	T	P	Total	Credit points
	0	0	3	3	1.5

Course Outcomes

After completion of the course, students will be able to

CSE2251.1: Understand and Apply different types of algorithm designing paradigms like divide and conquer, greedy, dynamic programming etc.
CSE2251.2: Realize and Apply underlying mathematical principles of algorithms in the corresponding implemented program.
CSE2251.3: Analyse and Evaluate the performance of various algorithms by observing the actual running time and main memory consumption of the corresponding implemented programs for best case, worst case and average case input data.
CSE2251.4: Create / Design a good algorithm for solving real life computing problems, by using various design techniques and data structures, learnt in this course.

A tentative list (non-exhaustive) of the practical topics is given below:

1. **Divide and Conquer:** Implement Quick Sort and **randomized version** of quick sort using Divide and Conquer approach. Check the running time for each of the n! combinations or input sequences of a particular set of integers to observe the best, worst and average cases.
2. **Divide and Conquer:** Implement Merge Sortusing Divide and Conquer approach. Check the running time for each of the n! combinations or input sequences of a particular set of integers to observe the best, worst and average cases.
3. Implement Heapsort algorithm. Check the running time for each of the n! combination or input sequences of a particular set of integers to observe the best, worst and average cases.
4. **Dynamic Programming:** Find the minimum number of scalar multiplications needed for chain of Matrices.
5. **Dynamic Programming:** Implement Bellman Ford Algorithm to solve Single Source shortest Path problem of a graph.
6. **Dynamic Programming:** Implement Floyd-Warshall Algorithm to solve all pair shortest path for a graph.
7. **Dynamic Programming:** Solve 0/1 Knapsack problem using dynamic problem.
8. **Dynamic Programming:** Solve Longest Common Subsequence problem using dynamic problem.
9. **Greedy method:** Implement Dijkstra's algorithm to find the single source shortest path of a directed, weighted graph by using minimum priority Queue or minimum heap data structure.
10. **Greedy method:** Implement Prim's algorithm to find Minimum Spanning Tree of a graph by using minimum priority Queue or minimum heap data structure.
11. **Greedy method:** Implement Kruskal's algorithm to find Minimum Spanning Tree of a graph by implementing and using various operations of Disjoint-set Forest data structure.
12. **Greedy method:** Implement Huffman coding using greedy approach.
13. **Realization of Amortized Analysis:** Implement a Queue using Stacks.
14. Implement KMP algorithm for string matching

15. Implement Ford-Fulkerson algorithm to get maximum flow in a given flow network.
16. **Randomized Algorithm:** Implement Skip-List)**.**

Textbooks

1. Introduction to Algorithms, Cormen, Leiserson, Rivest and Stein. Third Edition, 2009. Prentice Hall.
2. Algorithm Design, Jon Kleinberg and Eva Tardos. Addison Wesley, 2005.

Reference Books

1. Computer Algorithms: Introduction to Design and Analysis, Sarah Basee and Allen van Gelder. 3rd Edition, Addison Wesley.

Course Name: Computer Architecture Lab					
Course Code:CSE2252					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**1.5**

Course Outcomes

After completion of the course, students will be able to

CSE2252.1: have adequate knowledge of basics of computer architecture.
CSE2252.2: understand detailed implementation of machine instructions, their classifications and their relevance to programming paradigms.
CSE2252.3: acquire sufficient knowledge of design implementations of various arithmetic operations such as adder, multiplier etc.
CSE2252.4: design and simulate various combinatorial and sequential logic circuits using Vivado/Xilinx.
CSE2252.5: understand various memory functions.
CSE2252.6: design a formal test bench from informal system requirements.

Programming using VHDL

1. All Logic Gates (Data flow and Behavioral model)
2. Half adder and half subtractor (Data flow and Behavioral Model)
3. Combinatorial Designs (Data flow and Behavioral Model)
   a. 2:1 Multiplexer
   b. 4:1 Multiplexer
   c. 3:8 Decoder
   d. Comparator
4. Full adder and full subtractor (Data flow, Behavioral and Structural Model)
5. Sequential design of flip flops (SR, JK, D, T)
6. ALU design
7. Ripple carry adder (Structural Model)
8. Adder subtractor composite unit (Structural Model)
9. 4 bit synchronous and asynchronous counters.
10. Small projects like stepper motor.

Textbooks

1. VHDL: Programming by Example, Douglas L. Perry, Fourth Edition, McGraw Hill.

Reference Books

1. Introduction to Logic Circuits & Logic Design with VHDL, LaMeres, Brock J, Springer.

Course Name: AI Lab					
Course Code:AML2251					
Contact Hours per week:	L	T	P	Total	Credit points
	0	0	3	3	1.5

Course Outcomes

After completion of the course, students will be able to

AML2251.1: Remember and understand the working principles of PROLOG/ LISP
AML2251.2: Apply LIST structure of PROLOG as and when required
AML2251.3: Make use of CUT to the programs as and when required
AML2251.4: Solve the problems by using accumulator
AML2251.5: Apply the principles of reasoning and inference to real world problems
AML2251.6: Design programs to solve various puzzles.

In this laboratory students will be familiarized with PROLOG/ LISP language. A tentative outline is given below:

1. Introduction to PROLOG facts & rules with the help of a simple family tree; how the goals are given in PROLOG; some simple queries on the family tree
2. Formation of recursive definition; how PROLOG executes the goals; simple assignments
3. How PROLOG deals with problems with numbers – integers, real; with some examples
4. Introduction to LIST structure; how PROLOG implements LIST; some simple assignments on LIST.
5. Some more complex assignments on LIST; Introduction of Accumulators – simple assignments
6. Introduction to CUT with simple assignments; implementation of Sorting algorithms
7. PROLOG clauses for file operation – with simple assignments
8. Implementation of Graph Search algorithms like DFS, BFS; Some application of DFS & BFS
9. Implementation of some well-known puzzles, like 8-queens problem, Towers-of-Hanoi problem, Missionaries & Cannibals problem etc.
10. Introduction to LISP
11. Some simple assignments on LISP.

Textbooks

1. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India.

Reference Books
Logic and Prolog Programming, SarojKaushik, New Age International Publishers.

Course Name: Digital Circuit Design Lab					
Course Code:ECE2052					
Contact Hours per week:	L	T	P	Total	Credit points
	0	0	3	3	1.5

Course Outcomes

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

ECE2052.1: Define different types of logic gate ICs, verify their truth table and realize the Boolean expression using logic gates.
ECE2052.2: Design and developed code converters and simple arithmetic circuits like adder, subtractor etc.

ECE2052.3: Design and test combinational circuits.

ECE2052.4: Design and develop sequential circuits like flip-flops and counters.

List of Experiments:

1. Realization of basic gates using Universal logic gates.
2. Realization of code conversion circuits - BCD to Excess-3 and vice-versa.
3. Construction of simple arithmetic circuits - Adder, Subtractor.
4. Design of Parity Bit Generator and Checker circuits.
5. Construction of Decoder circuit using logic gates.
6. Construction of Multiplexer circuit using logic gates and realization of different combinational logic circuits using Multiplexer.
7. Design of 2-Bit Comparator Circuit.
8. Realization of RS, D and JK flip-flops using universal logic gates.
9. Realization of Asynchronous Up or Down counter.
10. Realization of Synchronous Up or Down counter.
11. Realization of Ring and Johnson's counters.

DETAILED SYLLABUS

3rd Year

Paper Name: Database Management Systems					
Paper Code: CSE3101					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course Outcomes

After completion of the course, students will be able to

CSE3101.1. Identify the basic concepts to model an application's data requirements using conceptual modeling tools like ER diagrams.

CSE3101.2. Formulate relational algebra expression for queries and evaluate it using the concept of query processing.

CSE3101.3. Create RDBMS schema mapping various business requirements and formulate queries using SQL.

CSE3101.4. Apply normalization and various types of dependencies for evaluating a relational database design.

CSE3101.5. Analyze and relate the concept of transaction, concurrency control and recovery in database.

CSE3101.6. Understand with basic database storage structures and access techniques, indexing methods.

Module I [12L]:

Introduction: An overview of database and database management system, Three-schema architecture of a database and data independence, Big data and NoSQL systems, XML systems, Cloud storage.

Relational Database Design using ER Model: Data modelling concepts, Notations for ER diagram, Drawing ER diagram, Concepts of Keys, Mapping Constraints, Extended E-R features, Convert ER diagrams into tables.

Module II [12L]:

Relational Data Model: Concept of Relations, Relational Algebra Operators.

SQL: Data definition in SQL, Integrity constraints, queries and nested sub-queries, join, aggregate functions, views, use of PL/SQL.

Query Processing and Optimization: Query Trees and Query Graphs, Translating SQL into relational algebra, Query Optimizer Concepts.

Module III [12L]:

Dependency theory: Relational database design, Functional dependencies, Closure, Primary Keys and Candidate Keys.

Data Base Design & Normalization: Different anomalies in designing a Database, Normalization and different Normal Forms (1NF, 2NF, 3NF and BCNF), Lossy and Loss-less join decompositions, Dependency preservation, Normalization using multi-valued dependencies and 4NF, Join dependency, Definition of 5NF.

Module IV [12L]:

Transaction management and Concurrency control: Transaction Fundamental, ACID properties, Conflict serializability, Concurrency control schemes, Lock-Based Concurrency Control (2PL), Schedule recoverability, Overview of Deadlock in DBMS.

Physical database design: Indexing Structures, B tree and B+ tree index.

Introduction to NOSQL and Bigdata storage systems: Document based NOSQL systems and MongoDB, Bigdata technologies based on Hadoop and MapReduce.

Textbooks:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", 4th Ed., McGraw Hill, Computer Science Series.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Pearson.
3. Date C. J., "Introduction to Database Management", Vol. I, II, III Pearson.
4. Kristina Chodorow, "MongoDB: The Definitive Guide - Powerful and Scalable Data Storage", O'REILLY
5. Ajit Singh, Sultan Ahmad, "MongoDB Simply In-Depth", 2019

Reference Books:

1. R. Ramakrishnan, J. Gehrke, "Database Management System", McGraw-Hill.
2. A. Reuter and J. Gray, "Transaction Processing: Concepts and Techniques", Morgan Kauffman Publishers.
3. Ullman J. D., "Principles of Database Systems", Galgottia Publication.
4. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi.
5. A. K. Majumdar, P. Bhattacharya,"Database Management Systems", Tata McGraw Hill.

6. S. Bradshaw, E. Brazil, K. Chodorow, "Mongo DB: The Definitive Guide 3e: Powerful and Scalable Data Storage" O'REILLY

Paper Name: **Fundamentals of Machine Learning**					
Paper Code: **AML3001**					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes

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

AML3001.1. Learn and understand the basics of machine learning approaches and paradigm.

AML3001.2. Understand and describe various machine learning algorithms.

AML3001.3. Understand complexity of Machine Learning algorithms and their limitations.

AML3001.4. Mathematically analyse various machine learning approaches and paradigms

AML3001.5. Analyse various machine learning techniques to get an insight of when to apply a particular machine learning approach.

AML3001.6. Apply common Machine Learning algorithms in practice and implementing their own using real-world data.

Module I [9L]

The learning Problem: Example of learning, Components of learning, A simple model, Types of learning;

The Linear Model I: Input Representation, Linear Classification, Linear and Logistic Regression, Nonlinear Transformation.

Module II [9L]

Error and Noise; **Training vs. Testing:** From Training to Testing, Dichotomies, Growth Function, key notion: Break Points;

The VC Dimension: The definition, VC Dimension of Perceptrons, Interpreting the VC Dimension, Utility of VC Dimension.

Bias-Variance Tradeoff: Bias and Variance, Learning Curves.

Module III [9L]

The linear Model II: Logistic Regression, Nonlinear Transformation, Likelihood measure, Gradient Descent;

Neural Networks: Neural Network Model, Backpropagation algorithm; Introduction to Radial Basis Function, Recurrent Neural Network, Convolution Neural Network and Deep Neural Network**.**

Module IV [9L]

Support Vector Machines (SVM): The Margin, Maximizing the Margin, The solution, Support Vectors, Nonlinear Transform; Kernel Methods: The Kernel methods, Soft-margin SVM; Overfitting: What is overfitting? Dealing with overfitting; Regularization: Regularization - informal, Regularization – formal, Weight decay, Choosing a regularizer.

Textbooks

1. Learning from Data - A short Course, Y. S. Abu-Mostafa, M. Magdon-Ismail, H. T. Lin, AMLbook.com.
2. Computational Intelligence Principles, Techniques and Applications, Konar, Springer, 2012.
3. Machine Learning, First Edition, T. Mitchell, McGraw-Hill, 1997.

Reference Books

1. Neural Networks and Learning Machines, Third Edition, S. Haykin, PHI Learning, 2009.
2. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2010.
3. Deep Learning, Ian Goodfellow, YoshuaBengio, Aaron Courville, Francis Bach, MIT Press, 2017.

Course Name: Introduction to Operating Systems					
Course Code:AML3102					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

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

AML3102.1. Develop knowledge about the importance of computer system resources and the role of operating system in their management policies and algorithms.
AML3102.2. Understand processes and its management policies and scheduling of processes by CPU.
AML3102.3. Acquire an understanding of the need of process synchronization, evaluate the requirement for process synchronization and coordination handled by operating system.
AML3102.4. Analyse the memory management and its allocation policies and compare different memory management approaches.
AML3102.5. Understand the impact and co-relation of different scheduling algorithm in secondary storage and different structure of file system and able to design the system with improved performance.
AML3102.6. Identify the different activities and impact of threat, virus, worm and able to protect system from them.

Module I [7L]

Introduction: Operating system functions, OS Architecture (Monolithic, Microkernel, Layered, Hybrid), Different types of O.S. (batch, multi-programmed, time-sharing, real-time, distributed, parallel).

System Structure: Computer system operation, Operating system structure (simple, layered, virtual machine), O/S services, System calls.

Protection & Security: Goals of protection, Domain of protection, Access matrix and its representation, Threats and system security.

Module II [13L]

Processes and Threads: 7 state process model, Process scheduling, Operations on processes, Inter-process communication, Threads overview, Benefits of threads, User and kernel threads.

CPU Scheduling: Scheduling criteria, Preemptive & non-preemptive scheduling, Scheduling algorithms (FCFS, SJF, RR, Priority, Multi-level queue, Multi-level feedback queue), Comparative study of the algorithms, Multi-processor scheduling.

Process Synchronization: Background, Critical section problem, Software solution – Peterson and Bakery algorithm, Synchronization hardware, Semaphores, Classical problems of synchronization.

Deadlocks: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

Module III [9L]

Primary Memory: Background, Physical address, Logical address, Virtual address, Contiguous memory allocation (Fixed and Variable partition), Non-contiguous memory allocation techniques (Paging, Segmentation, Segmentation with Paging), Virtual memory, Demand Paging, Performance, Page replacement algorithms (FCFS, LRU, optimal), Thrashing.

Secondary Storage: Disk structure, Disk performance, Disk scheduling (FCFS, SSTF, SCAN, C-SCAN),Boot block, Bad blocks.

Module IV [7L]

File Systems: File concept, Access methods, Directory structure, File system structure, Allocation methods (Contiguous, Linked, Indexed), Free-space management (Bit vector, Linked list, Grouping), Directory Implementation (Linear list, Hash table), Efficiency and Performance.

I/O Management: PC Bus Structure, I/O connections, Data transfer techniques (Programmed, Interrupt driven , DMA), Bus arbitration (Daisy chain, Polling, Independent request), Blocking and non-blocking I/O, Kernel I/O subsystem (Scheduling, Buffering, Caching, Spooling and device reservation, Error handling).

Textbooks

1. Operating System Concepts, 10E, Silberschatz A., Galvin P. B., Gagne G., Wiley Publications.
2. Operating Systems Internals and Design Principles, 9E, Stalling W., Pearson Education.

Reference Books

1. Operating System: Concept & Design, Milenkovie M., McGraw Hill.
2. Operating System Design & Implementation, Tanenbaum A.S., Prentice Hall NJ.
3. Operating System Concepts, Silberschatz A., Peterson J. L., WileyPublications.
4. Operating Systems A Concept Based Approach, Dhamdhere D.M., McGraw Hill.

Paper Name: Web Technologies					
Paper Code: CSE3133					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

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

CSE3133.1. Understand the basic tags of HTML, CSS, java script and DHTML.

CSE3133.2. Connect a server-side program using servlet and JSP to a DBMS and perform insert, update and delete operations on DBMS table.

CSE3133.3. Write a server-side program using servlet and JSP to store the data sent from client, process it and store it on database.

CSE3133.4. Prepare a well formed / valid XML document, schema to store and transfer data.

CSE3133.5. Understand various types of attacks and their characteristics.

CSE3133.6. Get familiar with network security designs using available secure solutions (such as PGP, SSL, IPSec).

Module I [8L]:

Introduction: Commonly used protocols: HTTP, HTTPs, TELNET, Electronic Mail-POP3, SMTP etc., WWW-Evolution and its characteristics.

Basics of Web Technology: Static web page, Dynamic web page, Active web page.

HTML and CSS: Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block,

Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue. Image Maps.

Module II [10L]:

Web page scripting, server and client side: Java Script: Data types, variables, operators, conditional statements, array object, date object, string object.

Extensible Markup Language (XML): Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief.

Java Servlet: Servlet environment and role, HTML support, Servlet API, The servlet life cycle, Cookies and Sessions.

Module III [10L]

Advanced Java Server Side Programming: JSP: JSP architecture, JSP servers, JSP tags, understanding the layout in JSP, Declaring variables, methods in JSP, inserting java expression in JSP, processing request from user and generating dynamic

response for the user, using include and forward action, Creating ODBC data source name, introduction to JDBC, prepared statement and callable statement. J2EE: An overview of J2EE web services**.**

Module IV [8L]

Network Security: Threats: Malicious code-viruses, Trojan horses, worms; Active and Passive attacks: eavesdropping, spoofing, modification, denial of service attacks.

Network security techniques: Password and Authentication; VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL).

Firewall: Introduction, Packet filtering, Stateful, Application layer, Proxy.

Textbooks

1. Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML and Ajax, Dreamtech Press; first edition.
2. Web Technologies, Godbole and Kahate, Tata McGraw-Hill Education.
3. Web Technologies: A Computer Science Perspective, Jeffrey C. Jackson, Pearson,2011.

Reference Books:

4. Introduction to Web Technology By Pankaj Sharma
5. Web Technology By Gopalan and Akilandeswari

Course Name: Randomized Algorithms					
Paper Code: CSE3135					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
After the completion of the course, students will be able to:
CSE3135.1. Remember and understand the basic principles of any randomized algorithm, like basic probability, expectations etc.
CSE3135.2. Understand the theories behind various randomized algorithms, streaming algorithms, online algorithms
CSE3135.3. Apply the concepts of probability to solve various combinatorial problems involving random graphs
CSE3135.4. Analyze the performance of randomized algorithms.
CSE3135.5. Apply the well-known probabilistic bounds to determine the computational complexity of randomized algorithms
CSE3135.6. Design a randomized algorithm for the new problem given to them

Module I: [9L]
Introduction, Basics of Probability, Monte Carlo and Las Vegas Algorithms, Karger's Min-cut Algorithm,
Quicksort, Verifying Polynomial Identities. Expectations, MVV Perfect Matching Algorithm

Module II: [9L]
Randomized Median Finding. Chernoff Bounds, Concentration Inequalities, Set Balancing, Introduction to high-dimensional probability, Sub-Gaussian and Sub-Exponential distribution, Hoeffding's inequality, Bernstein's inequality.

Module III: [9L]
Applications of probability in combinatorics: balls and bins, probabilistic methods, random graphs.

Module IV: [9L]
Advanced algorithms: Hashing and its variants, Primality testing, approximate counting, Streaming Algorithms, Online Algorithms.

Text Books:

1. Rajeev Motwani, Prabhakar Raghavan. Randomized Algorithms, Cambridge university press.
2. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson Education.

Reference Books:

1. Amit Chakrabarti, Data Stream Algorithms, 2020.
2. Michael Mitzenmacher and Eli Upfal, Probability and Computing: Randomized Algorithms and Probabilistic Analysis, Cambridge University Press, New York, USA, 2005.

Paper Name: Introduction to Soft Computing					
Paper Code: AML3131					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes

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

AML3131.1. Learn about soft computing techniques and their applications.

AML3131.2. Understand Local and Global optimal solutions for complex optimization problems.

AML3131.3. Analyse various neural network architectures.

AML3131.4. Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic.

AML3131.5. Understand the genetic algorithm concepts for real life problems.

AML3131.6. Identify and apply a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution.

Module I [9L]

Introduction: Introduction to Soft Computing, Different tools and Techniques, Usefulness and applications.

Fuzzy sets and Fuzzy logic: Definition, Fuzzy sets versus crisp sets, Fuzzy Membership Functions, Fuzzification & De-Fuzzification, Fuzzy set theoretic operations, Fuzzy Arithmetic, Extension Principle, Fuzzy numbers, Linguistic variables, Fuzzy logic, Linguistic hedges, Fuzzy rules and fuzzy reasoning, Fuzzy inference systems, Introduction to Rough Set.

Module II [9L]

Artificial Neural Network: Introduction, Supervised & Unsupervised Learning, basic models, Hebb's learning, Perceptron, Multilayer feed forward network, Back propagation algorithm, Competitive learning, Self-Organizing Feature Maps.

Module III [9L]

Evolutionary Algorithms Introduction to Genetic Algorithm (GA), GA operators, different types of encoding, selection rules, elitist model, Schema theorem and convergence of Genetic Algorithm, Introduction to MOOA, Pareto optimal front, Multi Objective Genetic Algorithm (MOGA). VEGA, NSGA, NSGA-II.

Module IV [9L]

Swarm Intelligence Techniques: Introduction, Key Principles of Swarm, Overview of Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO) techniques with Applications, Introduction to Granular Computing.

Advance Neural Network Systems: Genetic Algorithm for Neural Network Design and Learning, Basic idea of 3rd generation Neural networks.

Reference Books

1. Davis E. Goldberg, Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley.
2. Cin- Teng- Lin, C. S. George Lee, Prentice Hall, Neural Fuzzy Systems: A neuro Fuzzy Synergism to intelligent Systems.
3. B. Yegnanarayana, Artificial Neural Networks, PHI.
4. S. Rajasekaran and G. A. Vijaylakshmi Pai. Neural Networks Fuzzy Logic, and Genetic Algorithms, PHI.
5. Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill.
6. K. H. Lee. First Course on Fuzzy Theory and Applications, Springer-Verlag.

Paper Name: Introduction to Information Retrieval					
Paper Code: AML3133					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completion of course, students would be able to:

AML3133.1. Identify basic theories and analysis tools as they apply to information retrieval.

AML3133.2. Develop understanding of problems and potentials of current IR systems.

AML3133.3. Learn and appreciate different retrieval algorithms and systems.

AML3133.4. Apply various indexing, matching, organizing, and evaluating methods to IR problem

AML3133.5. Be aware of current experimental and theoretical IR research.

AML3133.6. Analyze and design solutions for some practical problems.

Module I [9L]

Information retrieval model, Information retrieval evaluation; Document Representation – Boolean Model, Posting Lists; Inverted Indices, Skip Lists; Query languages and query operation – proximity search, Phrase Queries Meta- data search; Tolerant Retrieval – B-Trees, Permuterm Index, Edit Distance – Different variations

Module II [9L]

Indexing Construction and Searching – BSBI, SPIMI, Heap's Law Zip's Law; Scoring and ranking feature vectors, tf-idf; various schemes; Evaluation and computations of scores and ranked retrieval; Relevance feedback

Module III [9L]

Text and multimedia languages, Language Models – Query Likelihood Models; Text Classification and Naïve Bayes-Bernoulli model, feature selection; Vector Space Classification – kNN, Rocchio Classification

Module IV [9L]

Flat Clustering – K means, K medoids, Evaluation of clustering, Models for clustering; Hierarchical Clustering – Single Link, Complete Link, Group Average and Centroid, Inversion Points, Divisive Clustering – Basics; Latent Semantic Analysis – SVD, Low Rank Approximations;

Web Search Basics, Link Analysis – Page Rank, HITS.

Text Books:

1. C. D. Manning, P. Raghavan and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008 (available at http://nlp.stanford.edu/IR-book).
2. Chakrabarti, S. (2002). Mining the web: Mining the Web: Discovering knowledge from hypertext data. Morgankaufman.
3. B. Croft, D. Metzler, T. Strohman, Search Engines: Information Retrieval in Practice, Addison Wesley, 2009. (available at http://ciir.cs.umass.edu/irbook/).

Reference Books:

1. R. Baeza-Yates, B. Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley, 2011 (2nd Edition).

Paper Name: Linear Algebra for Data Analysis					
Paper Code: MTH3131					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

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

MTH3131.1. Explain concepts of diagonalization, orthogonal diagonalization and Singular Value Decomposition (SVD).

MTH3131.2. Discuss basis, dimension and spanning sets.

MTH3131.3. Design Gram-Schmidt Orthogonalization Process and QR decomposition using concepts of inner product spaces.

MTH3131.4. Analyze Least squares solutions to find the closest line by understanding projections.

MTH3131.5. Define linear transformations and change of basis.

MTH3131.6. Illustrate applications of SVD such as, Image processing and EOF analysis, applications of Linear algebra in engineering with graphs and networks, Markov matrices, Fourier matrix, Fast Fourier Transform and linear programming.

Module I: [9L]:

Characteristic equations, Eigen Values and Eigen vectors, Diagonalization, Applications to differential equations, Symmetric matrices, Positive definite matrices, similar matrices, Singular Value Decomposition, Generalized Inverses.

Module II: [9L]:

Definition of Field, Vector Spaces, Elementary Properties in Vector Spaces, Subspaces, Linear Sum of Subspaces, Spanning Sets, Linear Dependence and Independence, Basis and Dimension. Application to matrices and system of linear equations.

Module III: [9L]:

Inner Product Spaces, Concept of Norms, Orthogonality, Projections and subspaces, Orthogonal Complementary Subspaces, Orthogonal Projections, Gram-Schmidt Orthogonalization Process, Least square approximations, QR decomposition.

Module IV: [9L]:
Linear Transformations, kernels and images, The Rank-Nullity-Dimension Theorem. Matrix representation of a Linear Transformation, Change of Basis, Linear space of linear mappings.

Text Book:
1. Linear Algebra and its Applications: Gilbert Strang (Thomson Brooks/Cole Cengage Learning)

Reference Books:
1. Matrix Computations: Gene H. Golub, Charles F. Van Loan (JHU Press)
2. Linear Algebra: Kenneth M. Hoffman, Ray Kunze (Prentice-Hall)
3. Linear Algebra A Geometric Approach: S. Kumaresan(PHI)

Paper Name: **Introduction to Image Processing**					
Paper Code: **AML3141**					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes

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

AML3141.1. Understand the general terminology, basic concepts and applications of digital image processing.

AML3141.2. Implement two dimensional filters in both spatial and frequency domain for image enhancement.

AML3141.3. Analyze and develop various image restoration techniques.

AML3141.4. Evaluate the methodologies for image segmentation, compression etc.

AML3141.5. Implement various morphological algorithms.

AML3141.6. Apply image processing algorithms in practical applications.

Module I [9L]

Introduction: Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.

Digital Image Formation: A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Sampling & Quantization.

Mathematical Preliminaries: Neighbor of pixels, Connectivity, Relations, Distance Measures, Arithmetic/Logic Operations.

Module II [9L]

Image Enhancement: Spatial Domain Method, Frequency Domain Method, Contrast Enhancement - Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.

Digital Image Transforms: Basis for transformation, Introduction to Fourier Transform, DFT, FFT, Properties of Fourier Transform, DCT, Walsh Transform, Hadamard Transform, Haar Transform.

Module III [9L]

Image Restoration: Degradation Model, Algebraic Approach to Restoration - Unconstrained & Constrained, Constrained Least Square Restoration, Homomorphic Filter.

Introduction, coding Redundancy , Inter-pixel redundancy, image compression model, Lossy and Lossless compression, Run length coding , Shannon-Fano Coding, Huffman Coding, Arithmetic Coding, LZW coding, Transform Coding, Sub-image size selection, blocking, DCT implementation.

Module IV [9L]

Morphological Image Processing: Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Reconstruction by dilation and erosion.

Image Segmentation: Introduction, Detection of isolated points, line detection, Edge detection, Edge linking, Region based segmentation- Region growing, split and merge technique, local processing, regional processing, Hough transform, Segmentation using Threshold.

Text Books

1. Digital Image Processing, Gonzalves, Pearson
2. Digital Image Processing, Jahne, Springer India
3. Digital Image Processing &Analysis, Chanda&Majumder, PHI
4. Fundamentals of Digital Image Processing, Jain, PHI.

Paper Name: **Fundamentals of Computer Networks**					
Paper Code: **AML3142**					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes

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

AML3142.1. Learn the terminologies and structures of a computer network and the need for the layered architecture.

AML3142.2. Learn about the various transmission media, modulation, multiplexing and switching techniques used in the physical layer and analyze their performance

AML3142.3. Understand the concepts of protocols, network interfaces, and design/performance issues in data link, network and transport layers

AML3142.4. Analyze and demonstrate the different types of routing techniques

AML3142.5. Defend and argue the various quality of service measures to improve network performance.

AML3142.6. Synthesize the strength and shortcomings of the congestion control algorithms and protocols, and then go on to hypothesize better protocols.

Module I [9L]

Introduction: Direction of data flow (simplex, half duplex, full duplex), Network topology, categories of network (LAN, MAN, WAN).

Protocols and standards: Reference models: OSI reference model, TCP/IP reference model, their comparative study

Physical Layer: Digital signal coding, Analog Modulation (AM, FM, PM) and Digital Modulation (ASK, FSK, PSK), Multiplexing, Switching, Transmission Media and its properties.

Module II [9L]

Data link layer: Framing / Stuffing, Error detection and correction.

Flow Control Protocols: Stop-and-Wait / Go-Back-N / Selective Repeat; HDLC, PPP.

MAC sub-layer: Ethernet (IEEE 802.3): ALOHA / CSMA-CD / Collision Resolution, Controlled Access and Channelization methods.

Devices: Transparent Bridges / Source-Route Bridges / Ethernet Switches; Backward Learning Algorithm; Construction of Spanning Trees; Routers.

Module III [9L]

IPv4: Packet format; Classful addressing / sub-netting / subnet mask; CIDR / super-netting / masks.

IPv6: address format / packet format / differences with IP (v4).

Protocols: IP, ARP, RARP

Routing algorithm: concept of static and dynamic routing, Distance vector / Link state algorithm.

Module IV [9L]

Transport Layer: Process to process delivery / multiplexing and other services of transport layer.
Transport Layer protocols: TCP: Three-way handshaking, Window management, Flow and congestion control with slow start, additive increase, multiplicative decrease; UDP; Difference between UDP and TCP.
General Congestion control algorithm: open and closed loop; Techniques to improve: QoS Leaky bucket / Token bucket.

Textbooks

1. Computer Networks, Andrew S. Tanenbaum, Pearson Education, Fourth edition.
2. Data and Computer Communication, William Stallings, Prentice Hall, Seventh edition.
3. High speed Networks and Internets, William Stallings, Pearson education, Second edition.

Reference Books

1. Cryptography and Network security, William Stallings, PHI, Third edition.
2. ISDN and Broadband ISDN with Frame Relay and ATM, William Stallings.
3. Computer Networking: A Top-Down Approach, 5th Ed., Kurose & Ross.

Paper Name: **Introduction to Software Engineering**					
Paper Code: **AML3143**					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes

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

AML3143.1. Prepare software requirement specifications as per IEEE guidelines.

AML3143.2. Model function-oriented and object-oriented software systems using industry standard techniques

AML3143.3. Approach Testing of software systems in a methodical manner.

AML3143.4. Estimate software size using industry-standard methods (e.g. FPA).

AML3143.5. Work out software project schedule and staffing plan.

AML3143.6. Identify software project risks and their mitigation approach.

Module I [9L]

Introduction to Software Engineering: Software Engineering – objectives and definitions, Software Life Cycle – different phases, Lifecycle Models - Waterfall, Relaxed Waterfall, RAD, Prototyping, Incremental, Spiral.

Modern Software Engineering practices: Agile: Values and Principles, Philosophy, Agile vs. Waterfall, Methods and Practices of Agile, Pitfalls of Agile methodology, Scrum: Roles, Workflow: Sprint, Daily Scrum, Sprint review etc., Limitations of scrum, Extreme Programming: Principles, Guidelines, Activities, Values, Practices, Introduction to DevOps and SEMAT.

Requirements Analysis and Specification Phase: Requirements Collection and Analysis, Requirement Specifications – General Structure of Software Requirement Specifications (SRS), Functional and Non-functional Requirements, Representing Requirements as Use Cases with examples.

Structured Analysis Modeling Techniques: Process Model using Context Diagrams (CD) and Data Flow Diagram (DFD) with examples, Data Dictionary

Module II [9L]

Design Phase: Overview, Attributes of Good Design, Design Approaches – Functional and Object-Oriented Design approaches, Design Aspects – Top-Down and Bottom-Up, Structured Design – Module Design (or High-Level Design), Detail Design (or Low-Level Design), Functional Decomposition – Abstraction, Structure Chart, Structured English, Design Issues – Cohesion, Coupling.

Object Oriented Analysis and Design: OOAD Basic Concepts, Unified Modeling Language (UML) – different types of diagrams for different views of system, User View – Use Case Diagram with examples, Structural Views – Class Diagram with examples, Behavioral View – Sequence, Collaboration, Activity and State Chart Diagrams with examples.

Module III [9L]

Coding or Programming: Programming Principles and Guidelines – Structured Programming, Code Re-use, Coding Standards / Guidelines, Coding Process – Incremental Coding, Test Driven Development, Pair Programming / Extreme Programming Source Code Version Control, Build, Code Refactoring.
Review and Testing: Self Review / Peer Review, Testing Overview-- Objective, Definition, Test Data, Stub and Driver, Testing Process – Test Case Design, Test Case Execution, Test Result, Testing Methods -- White Box Testing with Test Coverage using Control Flow Graph (CFG) and Cyclomatic Complexity, Black Box Testing with Equivalence Class Partitioning and Boundary Value Analysis, Testing Level – Unit Testing, Integration Testing, System Testing, (User) Acceptance Testing, Regression Testing, Performance Testing, Usability Testing, Non-functional Testing.

Module IV [9L]

Software Maintenance: Types of Maintenance – Corrective, Preventive, Adaptive Change Management and Maintenance Process models, Estimation of maintenance cost.
Software Estimation: Overview of Software Estimation – Size, Effort, Duration and Cost
Size Estimation Methods – Lines of Code (LOC) and Function Points (FP) Estimation of Effort and Duration based on Size and Productivity, Constructive Cost Model (COCOMO) – Basic COCOMO, Intermediate COCOMO (COCOMO 81), Detailed COCOMO (COCOMO II).
Project Management: Project Management Overview -Planning, Staffing, Execution, Monitoring and Control Responsibilities of Project Manager, Project Scheduling – Work Breakdown Structure (WBS) and Activity network, Gantt Charts, PERT chart, Determining the Critical Path.
Configuration Management: Overview of Configuration Management, Software Configuration Management tasks: Identification, Change Control, Version Control, Auditing,

Textbooks

1. Software Engineering: A Practitioners Approach, 5th Ed,R. S. Pressman, McGraw-Hill, 2001.
2. Software Engineering, 7th Ed, Sommerville, Addison-Wesley, 2005.

Reference Books

1. Software Engineering: A Precise Approach, 3rd Edition, Pankaj Jalote, 2013.
2. Fundamentals of Software Engineering, 3rd Edition, Rajib Mall, 2013.
3. Fundamentals of Software Engineering, 2nd Ed, C. Ghezzi, M. Jazayeri and D. Mandrioli, Prentice Hall of India, 2003.

Paper Name: Introduction to Object Oriented Programming					
Paper Code: AML3144					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes

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

AML3144.1. Understand the principles of object-oriented programming.

AML3144.2. Compare the relative merits of C++ and Java as object-oriented programming languages.

AML3144.3. Understand the importance of error management and incorporate exception-handling in object-oriented programs.

AML3144.4. Apply multithreading techniques to improve performance.

AML3144.5. Apply the features of C++ and Java supporting object-oriented programming to develop modular applications.

AML3144.6. Analyze problems and estimate when object-oriented programming is an appropriate methodology to design and develop object-oriented software using C++ and Java.

Module I [9L]

Overview of Object-Oriented Programming Concepts: Difference between OOP and procedural programming – advantages & disadvantages. class, object, message passing, inheritance, encapsulation, polymorphism.

OOP with C++: Basic Programming Concepts: Data Types, Operators, Control Statements & Loops, Functions& Parameters.

Arrays, Pointers& References. Class & Object, Abstraction / Encapsulation, Access Specifier. Static Member, Friend Function. Constructor and Destructor.

Module II [9L]

OOP with C++: Function and Operator Overloading. Inheritance and Derived Class: Abstract Class, Runtime Polymorphism, Virtual Base Class, Overriding. Exception Handling. Namespaces, Class Template and Function Template.

Module III [9L]:

OOP with Java: Features of Java, Byte Code & JVM, Concepts of Java Application and Applet. Basic Programming Concepts: Data Types, Operators, Control Statements & Loops, Functions & Parameters, Array. String Handling Concepts & related Functions, Command Line Arguments. User Input through Scanner. Class & Object, Access Specifier, Static Members, Constructor, Garbage Collector, Nested & Inner Class: Function Overloading, Inheritance, Runtime Polymorphism, Abstract Class.

Module IV [9L]:

Package and Interface. Exception Handling: Types of Exception Classes, Use of Try & Catch with Throw, User-definedExceptions Classes. Threads, Communication and Synchronization of Threads: Multithreading, Thread Lifecycle, ThreadPriorities, Inter-thread Communication. Applet Programming (using Swing): Applet Lifecycle, Application & Applet, Parameter Passing, Event Model & Listener, I/O.

Textbooks

1. The C++ Programming Language, Stroustrup, Adisson Wesley.
2. Object Oriented Programming in C++, R. Lafore, SAMS.
3. Java 2.0 Complete Reference, H. Schildt, McGrawHill.

Reference Books

1. JAVA How to Program, Deitel and Deitel, Prentice Hall.
2. Programming with Java: A Primer, E. Balagurusamy, 3rd Ed. – TMH.

Open Elective-I

Paper Name: **Fundamentals of Sensors and Transducers**					
Paper Code: **AEI3122**					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

AEI3122.1. Memorize the knowledge on mechanical, electromechanical, thermal and acoustic, and optical sensors.

AEI3122.2. Identify and classify the sensors based on type of measureand such as strain, force, pressure, displacement, temperature, flow, etc.

AEI3122.3. Choose the application specific Sensors and Transducers.

AEI3122.4. Relate the sensors in various industrial applications.

AEI3122.5. Design and set up the sensing systems.

AEI3122.6. Create the applications of smart sensors

Detailed Syllabus

Module I [10L]

Fundamentals: Definition, principle of sensing and transduction, classification of transducers, static and dynamic characteristics of Transducers.

Resistive Transducers: Potentiometric transducer- Theory, type, symbol, materials, error calculations due to loading effects, sensitivity, and specifications.

Strain gauge- Theory, type, symbol, materials, gauge factor, temperature compensation and dummy gauge, Strain measurement circuit- quarter, half and full bridge configuration, and specifications.

Inductive Transducers: Principle, common types, Reluctance change type, Mutual inductance change type, transformer action type. LVDT- Construction, working principle, characteristics (modulated and demodulated).

Module II [8L]

Capacitive sensors: Parallel plate type- Variable distance, variable area, variable dielectric constant type, calculation of sensitivity, response characteristics, specifications, and applications.

Piezoelectric transducers: Piezoelectric effect, type, charge and voltage co-efficient and relationships, crystal model, materials, charge amplifier; Ultrasonic sensors- Liquid velocity and level measurements.

Module III [10L]

Contact type Thermal Sensors:
Resistance change type:
Resistance Temperature Detector (RTD) - materials, temperature range, R-T characteristics, configurations, specifications, and applications. Thermistors- materials, temperature range, R-T characteristics, applications and specification.
Thermo-emf sensor:
Thermocouple- Thermo electric laws, types, temperature ranges, series and parallel configurations, cold junction compensation, compensating cables.
Introduction to semiconductor type temperature sensors.
Non-Contact type Thermal Sensors:
Thermal Radiation sensors- types, constructions, working, temperature ranges and comparison.

Module IV [8L]

Radiation Sensors:
LED, LDR, photodiodes, Photovoltaic cells, photo emissive cell types, materials, construction, response, applications. Geiger counters, Scintillation detectors.
Introduction to smart sensors.

References:

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

Course Name: Water and Liquid Waste Management					
Course Code: CHE3121					
Contact Hours Per Week	L	T	P	TOTAL	CREDIT POINT
	3	0	0	3	3

Course Outcomes:

The objective of this course is to provide approaches of Domestic/ Industrial Water and Liquid Waste Management for interdisciplinary B Tech students. After completion of the course students will be able to:

CHE3121.1 Identify the importance of Legislative orders prevalent in India concerning Water and Liquid Waste Management.

CHE3121.2 Develop the methodology of Establishing and Operating Water and Liquid Waste intensive processes.

CHE3121.3 Develop the knowledge base on various water conservation technologies.

CHE3121.4 Understand the suitable parameters for wastewater treatment and their computation methodologies.

CHE3121.5 Design the Drinking Water and Wastewater Treatment plants following the standard code of practice.

CHE3121.6 Design the Liquid Waste Management Plan for selected process Industries.

Module I [10L]

Introduction to Water Quality and its Storage. Methodology of Water flow measurement; Classification and various Water and Wastewater Standards prevalent in India. Legislative aspects including Water Act. 1974 and its revisions; Consent to Establish and Consent to Operate water intensive industries; Water conservation methodologies in 1) Process industry, 2) Construction industry and 3) Service industry; Rainwater Harvesting and various recharge techniques. Principles of Water Audit.

Module II [10L] Water pollution:

Sources, sampling and classification of water pollutants, determination of basic parameters and computations associated with BOD, COD, TS, TDS, SS; Waste water treatment: primary, secondary, tertiary and advanced; aerobic treatment with special reference to activated sludge, trickling filter, RBDC and RBRC, EA;

Non-conventional:

WSP, anaerobic treatment with special reference to AFFR, UASB, numerical problems associated with all topics sited here.

Module III [10L]

Preliminaries of Water treatment processes;

Basic design consideration:

Pre-design, Raw water intake, Screening and aeration, Water conveyance, Coagulation, Flocculation and Precipitation, Sedimentation, filtration, colour, taste and odor control, Disinfections and fluoridation,

Water quality :

Physico Chemical and Bacteriological quality. Water Treatment Plant with design criteria: Slow sand bed and Rapid sand bed filter, layout, Process control, Non conventional water treatment processes and its design, numerical problems associated with all topics sited here.

Module IV [10L]

Liquid Waste Management in selected process industries:

Fertilizer, refineries and petrochemical units, pulp and paper industries, Tanneries, Sugar industries, Dairy, Alcohol industries, electroplating and metal finishing industries, Root Zone and Reed Bed Treatment for Effluents of small scale industries, Ranking of wastewater treatment alternatives. Case Studies.

Text Books:

1. Wendell P. Ela, Gilbert M. Masters, Introduction to Environmental Engineering and Science, PHI, Ed 3rd Edition.
2. Metcalf & Eddy, Wastewater Engineering, Tata Mc-Graw Hill – 2002.
3. Arceivala S.J., Wastewater treatment for pollution control, TMH, 2nd Edition.
4. Montogomery, J.M., Water Treatment Principles and Design, John Willey and Sons.

Books of reference:

1. Mahajan, S.P., Pollution Control in Process Industries, Tata Mc Graw Hill, 2008.
2. Davis M., Cornwell, D, Introduction to Environmental Engineering, Tata Mc GrawHill, 2012.
3. Standard Methods for Examination of Water and Wastewater, APHA / AWWA, 20th Edition.
4. Manual of Water Supply and Treatment: CPHEEO, Ministry of Urban Development, Govt. of India, 1999.
5. Water Treatment Plant Design, 5th Edition: ASCE and AWWA, 1912.
6. Design of Water treatment Plant - Part I, A G Bhole, Indian Water Works Association.

Course Name: Industrial Safety and Hazards					
Course Code: CHE3122					
Contact Hours Per Week	L	T	P	TOTAL	CREDIT POINT
	3	0	0	3	3

Course Outcomes:

After completion of the course students will be able to:

CHE3122.1: Use important technical fundamentals of chemical process safety and to impart basic knowledge that allows the students to evaluate occupational safety and health hazards in the workplace.

CHE3122.2: Analyze the effects of work place exposures, injuries and illnesses, fatalities.

CHE3122.3: Use safety programs to prevent or mitigate damage or losses and to develop preventative measure to avoid accident.

CHE3122.4: Use logic based quantitative risk analysis.

CHE3122.5: Carry out HAZOP analyses.

CHE3122.6: Use knowledge of safety and hazards in chemical plant layout.

Module I [10L]

Fundamental Concepts: Introduction to Process Safety:

Definition of safety, Concepts of Hazard and Risk, Safety program, Engineering ethics,

Inherent Safety:

Safety regulations, OSHA, FAR, Process safety management,

Introduction to Hazards:

Hazards due to fire, explosions and toxic chemicals,

Fire and Explosion:

Distinction between fire and explosion, Upper Flammability limit and Lower Flammability Limit, Fire Triangle, BLEVE, Runaway reaction.

Module II [10L]

Tools for Hazards Identification and Analysis:

Concepts of HAZOP, HAZOP Analysis

Logic Tree in Safety Analysis:

Concepts of Fault Tree and its analysis , Concepts of Event Tree and its analysis, Combination of frequencies , Duration of coincidence of events, Advantage of ETA, Comparison of FTA and ETA, Bath Tub Curve

Failure Mode and Effect Analysis:

Methodology of FMEA, Dow Fire and Explosion Index, Mond Index. Fire and Explosion Index

Module III [10L]

Risk Analysis Concept and Methodology:

Risk concept and measure of risk,

Risk Acceptance Criteria:

Quantitative risk analysis, Probit number. Fractional dead time

Module IV [10L]

Control of Chemical Plant Hazards:

Intensification and attenuation of hazardous materials, Industrial plant layout,

Industrial Ventilation:

Reasons for ventilation, Positive pressure ventilation, Dilution ventilation, TLV, TWA

Personal Protection:

Fire prevention, Personnel protection devices, Laboratory safety, Emergency safety, Safety systems.

Disaster Management:

Definition, Types of disaster, Complex Emergencies, Pandemic Emergencies, Preparedness, Disaster Response, Disaster Recovery

Case Studies:

Flixborough (England), Bhopal(India),Seveso(Italy),Pasadona (Texas)

Text Book:

1. Crowl D.A. and .Louvar J.F. Chemical Process Safety: Fundamentals with Applications: Prentice Hall, 1990.

Books of reference:

1. Kharbanda O.P. and Stall worthy E. Safety in Chemical Process Industries: Heinmann. Professional Publishing LTD.1988.
2. Wentz C.A. Hazardous Waste management: Mc-Graw Hill,
3. Cutter S.L. Environmental Risks & Hazards, Prentice Hall, 1994.
4. Trevor A. Kletz, What went wrong? Case Histories of Process Plant Disasters and How They Could Have Been Avoided, 5th, Edition, Butterworth-Heinemann/IChemE .

Course Name: Error Control Coding for Secure Data Transmission					
Course Code: ECE3123					
Contact Hours Per Week	L	T	P	TOTAL	CREDIT POINT
	3	0	0	3	3

Course Outcomes:

After completing the course the students will be able to:

ECE3123.1: Distinguish between different types of source codes.

ECE3123.2: Figure out equations for entropy, mutual information and channel capacity for all types of channels, utilizing their knowledge on the elements.

ECE3123.3: Explain and estimate the merit of various methods for generating and detecting different types of error correcting codes.

ECE3123.4: Formulate the basic equations of linear block codes, cyclic codes.

ECE3123.5: Outline the basics of convolution code, linear algebra and BCH code.

ECE3123.6: Develop overall understanding about different types of codes applied to both source and channel end during data transmission

Module I: Information theory, Source coding and channels [10L]

Information theory: Uncertainty and information, measure of information, Self and conditional Information, mutual information and entropy, Fixed length code, Variable length code, Prefix code, Instantaneous code, Kraft Inequality,

Source Code: Source coding theorem, Huffman codes, Shanon- Fano coding, Arithmetic code

Channels: Discrete memory less channel, Channel matrix for different channel models- Lossless channel, Deterministic channel, Noise-less channel, Deterministic channel capacity, channel coding, Information capacity theorem, The Shannon limit.

Module II: Error Control code: Linear Block Code [7L]

Block code: Hamming codes Minimum distance, Error detecting and Error-correcting capabilitiesof block code.

Linear Block Code: Definition & properties of linear block codes, Matrix description of linear blockcodes, Encoding of linear block code, parity check matrix, decoding of a linear block code, Syndromeand Error detection.

Module III: Cyclic and BCH code [10L]

Cyclic Code: Definition & properties of cyclic codes, Code Polynomials, Generator Polynomials, Division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Decoding of cyclic codes.

Galois Field: Introduction to Linear Algebra, Introduction to Galois Field, Primitive elements, generator polynomials in terms of minimal polynomials, Calculation of minimal polynomial.

BCH Code: Elementary concept of BCH Codes, Encoding and Decoding, Elementary concept of Reed Solomon Code.

Module IV: Convolution Codes: [9L]

Encoding convolution code: Polynomial description of convolution codes, Distance notions for convolution codes and the generating function.
Decoding of convolution codes: Viterbi decoder, distance and performance bounds forconvolution codes.
Example of convolution code - Turbo codes, Turbo decoding.
Graphical representation of convolution code: State diagram, Tree, Trellis diagram

Text Books:
1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Introduction to Error Control Codes – S Gravano; Oxford Press
3. Information and Coding - N Abramson; McGraw Hill.
4. Introduction to Information Theory - M Mansurpur; McGraw Hill.
5. Information Theory - R B Ash; Prentice Hall. 8. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall

Course Name: Introduction To VLSI Design					
Course Code: ECE3124					
Contact Hours Per Week	**L**	**T**	**P**	**TOTAL**	**CREDIT POINT**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completing the course the student will be able to:

ECE3124.1: Learn about VLSI Technology Growth as driven by Moore's law.
ECE3124.2: Understand Various VLSI Design Methodologies.
ECE3124.3: Design Digital Combinational logic, Circuits and Layout using CMOS Technology.
ECE3124.4: Design Digital Sequential logic and Circuits using CMOS Technology.
ECE3124.5: Learn RTL Design using Verilog Hardware Description Language.
ECE3124.6: Learn Basic Building Blocks of Analog Circuit using CMOS Technology.

Module I [4L] VLSI Design Methodology: Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node, VLSI Design Trend and Challenges. VLSI Design Cycle, Y-Chart, Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD: PLA, PAL, FPGA

Module II [14L] Digital VLSI Circuits: Unit1: MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Concept of Logical effort, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits (Latch and Flip flop), Read and write operations of 1T DRAM and 6T SRAM cell.
Unit2: CMOS Cross Section, Inverter Layout, Lambda Rule vs Micron Rule, Stick Diagram, Euler Path Algorithm

Module III [6L] Hardware Description Language: Introduction to Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed Mode. Frontend Design Flow using Verilog (Behavioral, RTL and Gate Level), Combinational and sequential circuits with various examples, FSM Example: Mealy Machine and Moore Machine.

Module IV[10L] Analog VLSI Circuits: MOS large signal model, Transconductance gain, MOS small signal model, MOS switch, MOS Diode, MOS Resistor, CMOS Current Source/Sink, Active Load, Voltage Dividers, CMOS Current Mirror.

Text Book:

1. CMOS VLSI Design, A Circuits and Systems Perspective (4th Edition) Author: Neil Weste, David Harris. Addison-Wesley, Pearson
2. Design of Analog CMOS Integrated Circuit, B. Razavi, Mc. GrawHill
3. Fundamentals of Digital Logic with Verilog Design, 3rd Edition, Brown and Vranesic, Mc. GrawHill

Reference Book:

4. Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, 2nd Ed., Oxford.
5. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
6. CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006

Course Title: Additive Manufacturing					
Course Code: MEC3121					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:
After completion of the course, students will be able to:
MEC3121.1: Understand the fundamentals of additive manufacturing processes and various applications.
MEC3121.2: Interpret the use of CAD interfaces for 3D modeling and slicing in additive manufacturing processes.
MEC3121.3: Illustrate the working principles and characteristics of various solid state-based additive manufacturing processes.
MEC3121.4: Compare the working principles and characteristics of various liquid state-based additive manufacturing processes.
MEC3121.5: Examine the working principles and characteristics of various powder based additive manufacturing processes.
MEC3121.6: Implement suitable post-processing techniques for various additive manufacturing processes.

Module I: [11L] Introduction and Application of Additive Manufacturing (AM)
Introduction: Evolution of AM/3D printing; Comparison with subtractive and forming processes; Advantages and Disadvantages of AM; Classification of AM processes; Significance of CAD interfaces and slicing operation;
Applications of AM: Product development – Proof of Concept, Prototyping, visualization aids, replacement parts, jigs and fixtures, moulds and casting;
Application sectors – aerospace, automobile, medical, jewelry, sports, electronics, food, architecture, construction and others.

Module II: [9L] Solid State-based AM Processes
Fused Deposition Modeling – working principle, process parameters, materials; Equipment and specifications; materials characterization; Laminated object manufacturing – working principle, process parameters, materials; Equipment and specifications; Applications, advantages, disadvantages, examples; Other solid-state processes – Ultrasonic consolidation, Thermal bonding, etc., and Post processing.

Module III: [9L] Liquid State-based AM Processes
Stereolithography (SLA) – working principle, process parameters, materials; Photopolymers; Photo polymerization, layering technology, Laser and Laser scanning; Equipment and specifications; Applications, advantages, disadvantages, examples; Solid ground curing: working principle, process parameters, materials; Equipment and specifications; Applications, advantages, disadvantages, examples, and Post processing.

Module IV: [10L] Powder Based AM Processes
Powder Bed Fusion (PBF) Processes – working principle, process parameters, materials; Powder fusion mechanism and powder handling; Various PBF processes (principle, materials, applications and examples) – Selective Laser Sintering (SLS), Electron Beam Melting (EBM), Laser Engineered Net Shaping, Binder Jetting; Comparison between PBF processes; Materials-process-structure-property relationships; relative advantages and limitations, and Post processing.

Text Books
1. Sabrie Soloman, 3D Printing & Design, Khanna Book Publishing Company, New Delhi, 2020.
2. C.P Paul, A.N Junoop, "Additive Manufacturing: Principles, Technologies and Applications," McGrawHill, 2021.
3. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications," World Scientific, 2015.

Reference Book
Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping and Direct Digital Manufacturing", Springer, 2015

Online Resources:
1. https://onlinecourses.nptel.ac.in/noc21_me115/preview
2. https://onlinecourses.nptel.ac.in/noc20_mg70/preview

Course Title: Total Quality Management (TQM)					
Course Code: MEC3123					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

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

MEC3123.1: Explain the concepts of Total Quality Management and Total Quality Education, Report Quality Cost measure, Customer Satisfaction Index.

MEC3123.2: Identify the problems in Quality Improvement Process, Use various QC tools, appreciate the benefits of implementing 5-S Techniques.

MEC3123.3: Apply various Quality Function Deployment (QFD) Techniques.

MEC3123.4: Analyze Statistical Process Control (SPC) data to improve processes, Design experiments for arriving at optimal solutions.

MEC3123.5: Appreciate the incorporation of ISO System standard and its benefits, Address issues relating to closure of NCR'S.

MEC3123.6: Propose how business leaders might plan and execute quality management in an organization, struggles to gain and sustain competitive advantage in today's global business arena.

Module I: [9L] Introduction

Definition of quality ; Quality control vs. Quality Assurance ; TQM- Components of TQM; TQM vs. TPM; Quality Gurus ; Quality Planning and Quality costs; Collection and reporting of quality cost information; Leadership role in TQM; Role of senior management in TQM; Implementation and Barriers to TQM ; Customer Satisfaction- Customer perception of quality- customer complaints- customer feedback- customer retention; Employee involvement.

Module II: [11L] QMS

(ISO 9000):

Evolution of QMS- ISO 9000 series of standards- Quality manual – ISO 9001 requirements; Different clauses of ISO 9001 system and their applicability in various business processes ; Registration of ISO 9001 : 2000 ; ISO 9001: 2000 Certification; Steps involved in ISO 9001: 2000 Certification; benefits/ limitations of ISO 9001:2000; Internal Audits and Implementation of ISO 9001:2000.

EMS (ISO 14000):

Concepts of ISO 14001; Requirements of ISO 14001; Benefits of ISO 14001

Module III: [9L] Continuous Improvement in Quality

PLAN-DO-CHECK-ACT (PDCA); 7 QC tools and their use for quality improvement; Quality Function Deployment; QFD team ; Benefits of QFD; QFD Process KAIZEN; 5 – S Principle; Concept of quality circles.

Module IV: [10L] Statistical Process Control

Basic statistical concepts ; control charts for variables; Group control charts ; Control charts for attributes; Acceptance Sampling - OC Curve ; Process capability; Sampling Plans ; Six Sigma and its applications; Design of experiments and Taguchi Methodology

Text Books

1. Total Quality Management – J.D. Juran , MHE.
2. Total Quality Management - Besterfield, Pearson Education.

Reference Books

Statistical Quality Control –M. Mahajan, Dhanpat Rai &Co.(Pvt.) Ltd.

Paper Name: Database Management Systems Lab					
Paper Code: CSE3151					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**1.5**

Course Outcomes:

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

CSE3151.1. Learn to use Entity Relationship Diagram (ERD) model as a blueprint to develop the corresponding relational model in a RDBMS system like Oracle DBMS.
CSE3151.2. Apply DDL component of Structured query language (SQL) to create a relational database from scratch through implementation of various constraints in Oracle RDBMS system.
CSE3151.3. Apply DML component of Structured query language (SQL) for storing and modification of data in Oracle RDBMS system.
CSE3151.4. Apply DQL component of Structured query language (SQL) to construct complex queries for efficient retrieval of data from existing database as per the user requirement specifications.
CSE3151.5. Conceptualize and apply various P/L SQL concepts like cursor, trigger in creating database programs.
CSE3151.6. Develop a fully-fledged database backend system using SQL and P/L SQL programming to establish overall integrity of the database system.

Creation of a database using a given ERD Model as blueprint:
SQL Data Definition Language - Create (and Alter) table structure, Apply (and Alter) constraints on columns/tables viz., primary key, foreign key, unique, not null, check. Verify/ Review the table structure (along with applied constraints) using appropriate data dictionary tables like user_constraints, user_cons_columns, etc. Create view, materialized view using one or more table.

SQL Data Manipulation Language - Insert into rows (once at a time/ and in bulk) from a table, Update existing rows of a table, Delete rows (a few or all rows) from a table.

Data Query Language (DQL):

Basic select-from-where structure - Usage of Top, Distinct, Null keywords in query, Using String and Arithmetic Expressions, Exploring Where Clause with various Operators and logical combination of various conditions, Sorting data using Order By clause. Usage of IN, LIKE, ALL keywords.

Introduction to Joins -Natural Joins, equi-join, non-equi-join, Self-Join, Inner Join, Outer (left, right) Join.

Set operations- Unions, Intersect, minus set operations on table data using SQL.

Using single row functions in Queries - NVL function (to handle ambiguity of null data), upper, lower, to_date, to_char functions, etc.

Using group/multiple row functions in Queries like Count, Sum, Min, Max, Avg, etc, using Group By and Having Clause, using Group By with Rollup and Cube.

Sub-query - Working with various nested structure of Sub Queries - use in from or where clause with more than one level of nesting, correlated sub-query- Ranking table data using correlated sub-query.

P/L SQL:

Stored Procedures and Functions- Basic programming constructs of PL / SQL like if, else, else-if, loop, while, for structure. Populate stored procedure variables with the data fetched from table using SQL command.

Working with Cursors - Creating Cursors, parameterized cursor, Locks on cursors, Exploring advantages of cursors.

Introduction to triggers - Constraints vs Triggers, Creating, Altering, Dropping triggers, use of for/ after/ instead of triggers, using trigger to validate/ rollback a Transaction, Automatically populate integer data based primary key columns (e.g., Id.) using trigger**.**

Textbooks

1. Database System Concepts, Henry F. Korth and Silberschatz Abraham, Mc.Graw Hill.
2. Fundamentals of Database Systems, ElmasriRamez and Novathe Shamkant, Benjamin Cummings Publishing Company.

Reference Books

SQL, PL/SQL: The Programming Language of Oracle (With CD-ROM) (English) 4th Revised Edition, Ivan Bayross, BPB Publications.

Paper Name: Fundamentals of Machine Learning Lab					
Paper Code: AML3051					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**1.5**

Course Outcomes:

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

AML3051.1. Write code the machine learning algorithm in C or Python.

AML3051.2. Understand and conceptualize the methods of machine learning and its applications.

AML3051.3. Design simple algorithms for pattern classification, code them with Python programming language and test them with benchmark data sets.

AML3051.4. Write program analyze and evaluate simple algorithms for pattern classification.

AML3051.5. Analyze and evaluate simple algorithms of estimation.

AML3051.6. Design complex machine learning algorithms using tools like Excel, R, TensorFlow, Weka.

List of Experiments:

- Regression (single and Multiple Variables) linear and non-liner;
- Logistic regression
- Classifiers - K-NN; Naïve Bayes Classifier; Perceptron; Multi Layer Perceptron.
- Clustering Algorithms - K-Means; DB-Scan
- Familiarization with a few ML Tools Excel; WEKA; R; Python; TensorFlow
- Applications of ANN and SVM using ML tools

Course Name: Introduction to Operating Systems Lab					
Course Code: AML3152					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**1.5**

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

AML3152.1. Understand and implement basic services and functionalities of the operating system using system calls.
AML3152.2. Describe and create user defined processes.
AML3152.3. Understand the benefits of thread over process and implement them.
AML3152.4. Synchronization programs using multithreading concepts.
AML3152.5 Use modern operating system calls and synchronization libraries in software to implement process synchronization.
AML3152.6. ImplementInter-process communication using PIPE.

Shell programming: Creating a script, making a script executable, shell syntax (variables, Conditions, control structures, functions and commands).
Process: starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
Signal: signal handling, sending signals, signal interface, signal sets.
Semaphore: programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).
POSIX Threads: programming with pthreadfunctions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)
Inter-process communication: pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO).

Textbooks
1. Your Unix The Ultimate Guide, Sumitabha Das, MH

Reference Books
1. Beginning Linux Programming, Neil Matthew, Richard Stones, Wrox.

Paper Name: **Introduction to Image Processing Lab**					
Paper Code: **AML3171**					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

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

AML3171.1 Familiarize with the basics of Image Processing using MATLAB

AML3171.2 Apply image enhancement techniques spatial and frequency domain.

AML3171.3 Apply various image sharpening techniques.

AML3171.4 Apply various kinds of Image compression techniques.

AML3171.5 Apply various image segmentation and morphological algorithms.

Programs:

1. Display of an Image (Binary & Gray Scale)
2. Implementation of Transformations of an Image
3. Implementation of Image Enhancement Techniques
4. Implementation of Histogram
5. Bit planes of an Image
6. Display of FFT of an image
7. Implementation of Image Smoothening Filters (Spatial Domain)
8. Implementation of Image Smoothening and sharpening Filters (Frequency Domain)
9. Implementation of image sharpening filters
10. Implementation of image Compression
11. Implementation of image morphological techniques
12. Implementation of edge detection
13. Implementation of image restoration

References:

1. Digital Image Processing by S. Sridhar
2. Digital Image Processing by S. Jayaraman, S. Esakkirajan and T.Veerakumar

Paper Name: **Fundamentals of Computer Networks Lab**					
Paper Code: **AML3172**					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes

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

AML3172.1. Learn the terminology and concepts of network management in Linux platform by understanding shell commands and implementing the same.

AML3172.2. Understand the concepts of protocols, network interfaces, and design/performance issues through programs.

AML3172.3. Understanding the need of dividing stream of data into smaller units and implementing program to send such data units across a network.

AML3172.4. Demonstrate various types of protocols to transfer packets of data from a source to destination machine.

AML3172.5. Understand the need of different types of Transport Layer Protocols and implement them through socket programming.

AML3172.6. Learn how to synthesize the learning gathered from different network layers to build useful, relevant and user-friendly applications with the objective to solve real life problems.

Detailed Syllabus

1. Implement Simple TCP Client Server Application.
2. Implement TCP Echo Server Client Application.
3. Implement TCP Chat Server Client Application.
4. Implement a File Server Client application.
5. Implement UDP Echo Server Client Application.
6. Implement UDP Time Server Client Application.
7. Implement multithreaded chat program.
8. Implement Web based protocol (looking up URLs, retrieving & examining content, posting a form etc.).
9. Implement Multicasting / Broadcasting socket I/O.
10. Implement Sliding Window Protocol using Non-Blocking I/O (try the Selective Repeat).
11. Implement Secured TCP echo protocol.
12. Experimenting on cross-platform network-based communication issues.

Textbooks

1. Computer Networks, Andrew S. Tanenbaum, Pearson Education, Fourth edition.
2. Data and Computer Communication, William Stallings, Prentice hall, Seventh edition.
3. High speed Networks and Internets, William Stallings, Pearson education, Second edition.

Reference Books

4. Cryptography and Network security, William Stallings, PHI, Third edition.
5. ISDN and Broadband ISDN with Frame Relay and ATM, William Stallings.
6. Computer Networking: A Top-Down Approach, 5th Ed., Kurose & Ross.

Paper Name: **Introduction to Software Engineering Lab**					
Paper Code: **AML3173**					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes

After completion of the course, students will be able to:
AML3173.1. Prepare SRS document for sample application system as per IEEE guidelines.
AML3173.2. Design sample software application problem using various UML diagrams (e.g. Use Case Diagram, Class Diagram, Sequence Diagram etc.) using tools like Microsoft Visio.
AML3173.3. Design test cases for sample application module(s).
AML3173.4. Estimate the project size, duration and cost for sample application system using industry standard method like FPA.
AML3173.5. Prepare project schedule.
AML3173.6. Plan the staffing for sample application system.

Detailed Syllabus
Exercises and Assignments on:

1. Preparation of Software Requirement Specification for sample application system(s) as per IEEE guidelines.
2. Designing a system using UML Diagrams for sample application problems: Use Case Diagrams, Class Diagrams and Sequence Diagrams using tools.
3. Designing Test Cases for sample application module(s).
4. Estimation of Project Size for sample application system(s) – Function Point Analysis (FPA).
5. Preparation of Project Schedule and Staffing Plan for sample software project(s).

Textbooks

1. Uml: A Beginner's Guide, Jason T. Roff, McGraw-Hill, 2002.
2. Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development, 3rd Edition, Craig Larman, 2004.

2. Reference Books
1. The IFPUG Guide to IT and Software Measurement edited by IFPUG, CRC Press, 2012.

Paper Name: Introduction to Object Oriented Programming Lab					
Paper Code: AML3174					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course Outcomes

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

AML3174.1. Apply object-oriented principles or features in software design process to develop C++ and Java programs for real life applications.

AML3174.2. Reduce the complexity of procedural language by employing operator overloading, inheritance and exception handling techniques for developing robust and reusable software.

AML3174.3. Develop programs using stream classes for various I/O operations and design concurrent programs using threads to maximize the use of processing power.

AML3174.4. Design applications for text processing using String class and develop user interactive applications using event handling.

AML3174.5. Analyse the difference between two object-oriented programming languages C++ and Java.

Detailed Syllabus

Assignments on C++:

Day 1

1.Introduction to OOPs concepts, Difference between Structure and Class

2. Use of Constructor and Destructor

Day 2

1. Function overloading, Friend Function, Friend Class

Day 3

1. Operator Overloading without using friend function

2. Operator Overloading with using friend function

Day 4

1. Inheritance: Single, Multilevel, Multiple, Hybrid

Day 5

1. Virtual Base class, Virtual Function, Abstract Class

Day 6

1. Exception Handling 2. Templates and namespace

Assignments on Java:

Day 7

1. Understanding Java platform, compilation, and execution of a java program.

2. Implement class, object, constructor, methods, and other OOP features.

Day 8

1. Inheritance Basics, more uses of constructor, method overriding, use of final.

Day 9

1. Object class, practical use of abstract class.

2. Using Interface for achieving multiple inheritance, implementation of package.

Day 10

1. Exception handing fundamentals, java built-in exceptions, Use of Scanner class for console input, use of own Exception
subclass.

Day 11

1. Java thread life cycle model and implementation approach, thread priority, implementation of synchronization.

2. I/O Basics, byte stream and character streams, reading and writing files.

Day 12

1. Applet life cycle implementation, text processing using Java predefined String, StringBuilder and StringBuffer classes.

Day 13

1. GUI basics and Window fundamentals, working with different Component, Container and Layout Managers.

Day 14

1. Event handling for interactive GUI application.

Textbooks

1. The C++ Programming Language, Stroustrup, Adisson Wesley.
2. Object Oriented Programming in C++, R. Lafore, SAMS.
3. Java 2.0 Complete Reference, H. Schildt, McGrawHill.

Reference Books

1. JAVA How to Program, Deitel and Deitel, Prentice Hall.
2. Programming with Java: A Primer, E. Balagurusamy – 3rd Ed. – TMH

APPENDIX – A

UPDATED GUIDELINES OF MASSIVE OPEN ONLINE COURSES (MOOCS) SCHEME

(WITH EFFECT FROM 2023-2024 ACADEMIC SESSION)

MOOCs for B.Tech. Honours Degree

For B.Tech. honours degree, a 4 - year B.Tech. student will have to earn 20 credits fromMOOCs from any established MOOCs platform in addition to 160 credits for B.Tech. degree. B.Tech. lateral entry students should earn 16 credit points from MOOCs in addition to the required credit for B.Tech. degree. Student should submit all the certificate s before the last date of submission of MOOCs for the B.Tech. Honours degree, through the department declared by office of the Controller of the Examinations.

Credit points from MOOCs Courses

All of the MOOCs courses are to be taken any MOOCs platform as per following scheme of credit points. Students should be advised to avoid the courses taught/offered through the curriculum in the offline/ class room mode.

1. **For NPTEL/Swayam platform: Credit points as specified in the platform**

2. **For other MOOCs platforms like Coursera, edX, Udemy, Simpilearn etc.**

i) Courses of 4 weeks to 7weeks:1 credit point
ii) Courses of 8 weeks to11weeks:2credit point
iii) Courses of 12 weeks to15weeks:3credit point
iv) Courses of 16 weeks or more:4 credit point

3. **For duration of MOOCs courses are available in hours**

i) For every 8 –15 hours of course: 1 credit point**.**
ii) For the courses with duration less than 8hours, multiple courses could be taken together (preferably in the same area) to consider 1 credit point. But where duration is available in weeks, count of hours will not be applicable.

The above structure is indicative only. Departmental Committee concerned may propose credit points of the courses offered through MOOCs platform based on the content and level beginner/ intermediate/ advanced) of the courses. However, for any critical judgment the matter will be referred to the Departmental Committee.

Department will submit the list of the students who have successfully completed the MOOCs course along with the details in the prescribed format to the Controller of Examinations as and when notified.

APPENDIX – B

OFFICE OF THE CONTROLLER OF EXAMINATIONS

HERITAGE INSTITUTE OF TECHNOLOGY, KOLKATA

MANDATORY ADDITIONAL REQUIREMENTS (MAR)

Activity List w.e.f. 2023-2024 Academic Year

	Activity	Points per Activity	Permissible Points (max)
1.	*MOOCS (SWAYAM / NPTEL / SPOKEN TUTORIAL / ANY TECHNICAL, NON-TECHNICAL COURSE) (PER COURSE)*		
a)	For 12 weeks duration/40 Hours	20	40
b)	For 8 weeks duration/30 Hours	15	
c)	For 4 weeks duration/20 Hours	10	
d)	For 2 weeks duration/10 Hours	5	
2.	*TECH FEST / FEST / TEACHERS DAY / FRESHER'S WELCOME*		
a)	Organizer	5	10
b)	Participant	3	6
3.	*RURAL REPORTING*	5	10
4.	*TREE PLANTATION AND UP-KEEPING (PER TREE)*	1	10
5.	*RELIEF / CHARITABLE ACTIVITIES*		
a)	Collection of fund / materials for the Relief Camp or Charitable Trusts	5	40
b)	To be a part of the Relief Work Team	20	
6.	*PARTICIPATION IN DEBATE / GROUP DISCUSSION / WORKSHOP / TECH QUIZ / MUSIC / DANCE / DRAMA / ELOCUTION / QUIZ / SEMINAR / PAINTING / ANY PERFORMING ARTS / PHOTOGRAPHY / FILM MAKING / LIFE SKILLS*	10	20
7.	*PUBLICATION IN NEWS PAPER, MAGAZINE, WALL MAGAZINE & BLOGS*	10	20
8.	*RESEARCH PUBLICATION (PER PUBLICATION)*	15	30
9.	*INNOVATIVE PROJECTS (OTHER THAN COURSE CURRICULUM)*	30	60
10.	*BLOOD DONATION*		
a)	Individual Blood donation	8	16
b)	Blood Donation Camp Organization	10	20
11.	*SPORTS / GAMES / ADVENTURE SPORTS / TREKKING / YOGA CAMP*		
a)	Personal Level	10	20
b)	College level	5	10
c)	University Level	10	20
c)	District Level	12	24
e)	State Level	15	30
f)	National / International Level	20	20
12.	*ACTIVITIES IN A PROFESSIONAL SOCIETY / STUDENT CHAPTER*	10	20
13.	*RELEVANT INDUSTRY VISIT & REPORT / HOTEL-EVENT MANAGEMENT TRAINING & REPORT (MINIMUM 3 DAYS WITH SUBMITTED REPORT)*	10	20
14.	*COMMUNITY SERVICE & ALLIED ACTIVITIES LIKE: CARING FOR THE SENIOR CITIZENS, UNDER-PRIVILEGED / STREET CHILDREN / ANIMAL CARE ETC. / TRAINING TO DIFFERENTLY ABLE*	10	20
15.	*SELF-ENTREPRENEURSHIP PROGRAMME*		
a)	To organise entrepreneurship programmes and workshops	10	20
b)	To take part in entrepreneurship workshop and get certificate	5	10
c)	Video film making on entrepreneurship	10	20
d)	Submit business plan on any project	10	20
e)	To work for start-up/as entrepreneur	20	40

Format for Report Submission

Name :

Department :

Year/Semester :

Title of the Activity :

Date :

Name of the organization :

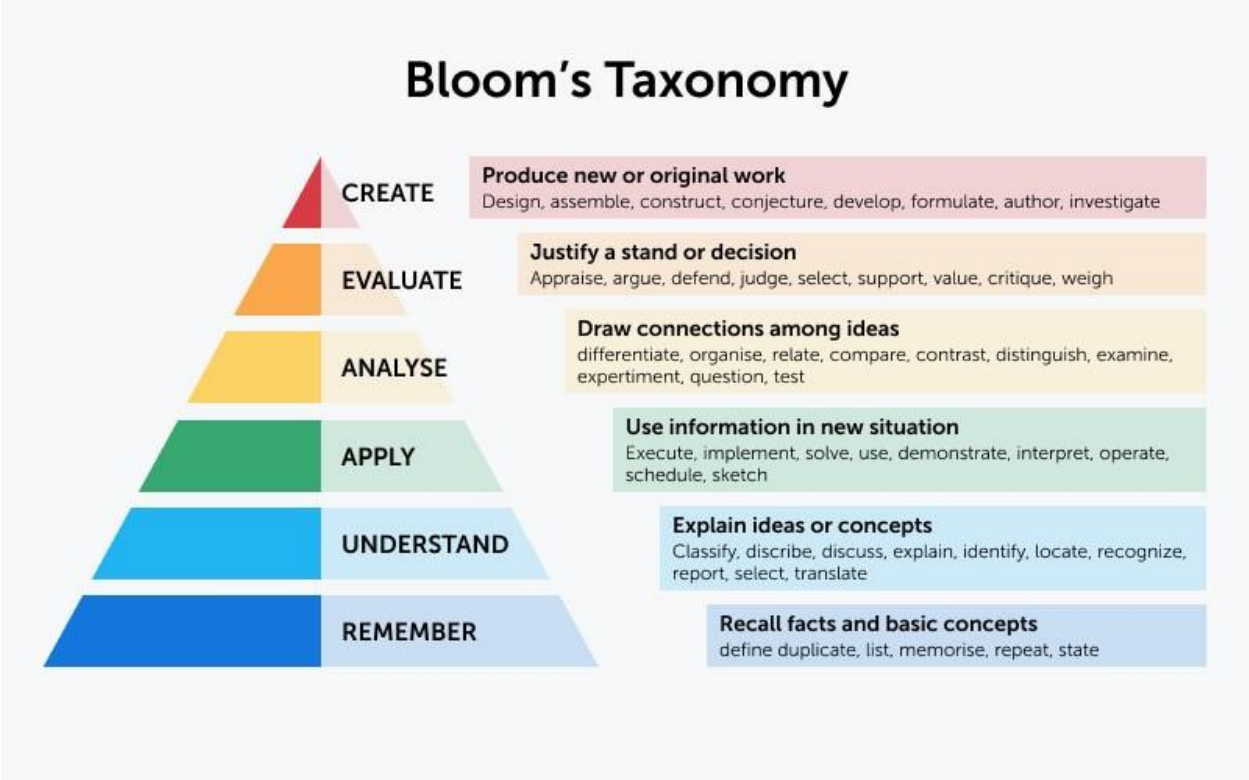
Report :

Signature
(Coordinator / Competent Authority)

Points earned:

Signature of the Mentor

APPENDIX – C


Bloom's Taxonomy
CREATE
Produce new or original work
Design, assemble, construct, conjecture, develop, formulate, author, investigate
EVALUATE
Justify a stand or decision
Appraise, argue, defend, judge, select, support, value, critique, weigh
ANALYSE
Draw connections among ideas
differentiate, organise, relate, compare, contrast, distinguish, examine, expertiment, question, test
APPLY
Use information in new situation
Execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch
UNDERSTAND
Explain ideas or concepts
Classify, discribe, discuss, explain, identify, locate, recognize, report, select, translate
REMEMBER
Recall facts and basic concepts
define duplicate, list, memorise, repeat, state