HERITAGE INSTITUTE OF TECHNOLOGY

(An Autonomous Institution affiliated to MAKAUT, West Bengal)

DEPARTMENT

OF

COMPUTER SCIENCE AND ENGINEERING

B. TECH. PROGRAMME

Curriculum and Detailed Syllabus

Release Date: JULY 2023

2nd Version: June 2024

(Applicable from 2023 admitted batch)

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Preamble

The curriculum for the B. Tech. in Computer Science and Engineering 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 the industry, academics and the different Accreditation bodies like NBA and NAAC. Courses such as Cloud Computing, NoSQL Database with MongoDB, Python and R programming, Design Thinking & Idea Lab, and DevOps 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, Discrete Mathematics, and Optimization theory are included to strengthen the mathematical skills of the students and make them more innovative. A plethora of Electives are available including Artificial Intelligence, Machine Learning, Deep Learning, and Natural Language Processing to enable the students to get accustomed to the latest trends in the computing domain whereas electives like Graph Algorithms and Randomized Algorithms give the options to sharpen their skills in theory. Inspired by the focus on internship in NEP 2020, it is now possible to accommodate a relatively longer internship in the industry during the last semester of the B. Tech degree. Students are being motivated to select and study 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. 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 21st century 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)

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

PEO1. Students will be receptive towards new ideas, path breaking entrepreneurial ventures, ever rising demands from the industry, and pioneering developments in academics. They will be able to respond to associated technical and social challenges with ease.

PEO2. Students will develop the attitude to value the importance of lifelong learning. They will be able to apply and share their technical knowledge for the holistic improvement of the socio-economic standards of the community

PEO3. Students will be able to organize their professional work and other priorities in their respective domains. They would be able to relate and compare problems and solutions across industrial R&D, academics and higher education.

PEO4. They will be well equipped to inculcate and hone their skills in their respective professional areas while working as part of a team.

PEO5. As and when the need arises, they will be able to lead the same group and pass on their own learning to their peers and subordinates in the group.

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)

PSO1. Reflex Action: Students should be able to identify the requirements to build a computational system for a given problem. The ability to categorize the different domains or areas of the sub-problems associated with the computational process should come to them naturally.

PSO2. Perceptual Action: After analyzing the sub problems, students should be able to formulate corresponding mathematical or logical model(s) for each of them, which are suitable for that domain or area.

PSO3. Physical Action: Students should be able to recognize the correct algorithmic approach for all the mathematical or logical problem(s). They will be well equipped to design appropriate and efficient algorithm(s) to solve those problem(s).

PSO4. Skilled Action: Students should be able to implement the algorithm(s) related to different computational areas. They will have gained enough expertise to assess the prospective results, analyze the efficiency of each algorithm and choose the optimal solution.

Credit Summary for B. Tech. Programmes in CSE with effect from 2023-2024

Sl. No.	Course Type	Credit CSE
1.	Humanities and Social Sciences including Management Courses	12
2.	Basic Science Courses	24
3.	Engineering Science Courses including Workshop, Drawing, Basics of Electrical / Mechanical / Computer, etc.	24
4.	Professional Core Courses	58
5.	Professional Elective Courses relevant to chosen Specialization / Branch	17
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 1st Semester

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 3rd 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	CSE2102	Operating Systems	3	0	0	3	3
3	ECE2002	Digital Circuit Design	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
6	EVS2016	Environmental Sciences (Mandatory)	2	0	0	2	0
Total Theory			**20**	**0**	**0**	**20**	**18**
B. Practical							
1	CSE2151	Data Structures and Algorithms Lab	0	0	3	3	1.5
2	CSE2152	Operating Systems Lab	0	0	3	3	1.5
3	ECE2052	Digital Circuit Design Lab	0	0	2	2	1
4	CSE2153	Software Tools Lab	0	0	3	3	1.5
Total Practical			**0**	**0**	**11**	**11**	**5.5**
Total of Semester			**20**	**0**	**11**	**31**	**23.5**

2nd Year 4th Semester

A. Theory							
Sl.	**Code**	**Subject**	**Contacts Periods/ Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	CSE2201	Design & Analysis of Algorithms	4	0	0	4	4
2	CSE2202	Computer Organization and Architecture	4	0	0	4	4
3	CSE2203	Object Oriented Programming	4	0	0	4	4
4	MTH2201	Algebraic Structures	4	0	0	4	4
5	AEI2205	Microprocessors and Microcontroller	2	0	0	2	2
Total Theory			**18**	**0**	**0**	**18**	**18**
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	CSE2253	Object Oriented Programming Lab	0	0	3	3	1.5
4	AEI2255	Microprocessors &Microcontroller Lab	0	0	2	2	1
5	CSE2254	Design Thinking and Idea Lab (CSE)	0	0	2	2	1
Total Practical			**0**	**0**	**13**	**13**	**6.5**
Total of Semester			**18**	**0**	**13**	**31**	**24.5**

3rd Year 5th Semester

A. Theory							
Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	CSE3101	Data base Management Systems	4	0	0	4	4
2	CSE3002	Formal Language & Automata Theory	4	0	0	4	4
3	ECE3106	Electronic Design Automation	2	0	0	2	2
4	CSE3131-CSE3140	Professional Elective-I	3	0	0	3	3
	CSE3131 CSE3132 CSE3133 CSE3134 CSE3135	Computer Graphics & Multimedia Data Mining & Knowledge Discovery Web Technologies Graph Algorithms Randomized Algorithms					
5	CSE3141-CSE3150	Professional Elective-II	3	0	0	3	3
	CSE3141 CSE3142 CSE3143	Artificial Intelligence Introduction to Data Analysis with Python and R Advanced Operating Systems					
6		Open Elective-I	3	0	0	3	3
	AEI3122 CHE3121 CHE3122 ECE3123 ECE3124 MEC3121 MEC3123	Fundamentals of Sensors & Transducers Water and Liquid Waste Management Industrial Safety and Hazards Error Control Coding for Secure Data Transmission Introduction to VLSI Design Additive Manufacturing 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	ECE3151	Electronic Design Automation Lab	0	0	2	2	1
3	CSE3171-CSE3180	Professional Elective - II LAB	0	0	2	2	1
	CSE3171 CSE3172 CSE3173	Artificial Intelligence Lab Introduction to Data Analysis Lab Advanced Operating Systems Lab					
Total Practical			**0**	**0**	**7**	**7**	**3.5**
Total of Semester			**19**	**0**	**7**	**26**	**22.5**

Open Elective - I offered by the Department of CSE							
1	CSE3121	Fundamentals of Operating Systems	**3**	**0**	**0**	**3**	**3**

3rd Year 6th Semester

A. Theory							
Sl.	**Code**	**Subject**	**Contacts Periods/ Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	CSE3201	Software Engineering	3	0	0	3	3
2	CSE3202	Computer Networks	4	0	0	4	4
3	HUM3201	Economics for Engineers	3	0	0	3	3
4	XXX3231 - XXX3240	Professional Elective-III	3	0	0	3	3
	CSE3231 CSE3232 CSE3233 CSE3234 CSE3235 CSE3236 CSE3237 IOT3231	Image Processing Enterprise Application in Java EE Machine Learning Compiler Design Cloud Computing NoSQL Database with MongoDB Real Time & Embedded System Big Data and IOT					
5	*****	Open Elective-II	3	0	0	3	3
6	INC3016	Indian Constitution and Civil Society (Mandatory)	2	0	0	2	0
Total Theory			**18**	**0**	**0**	**18**	**16**
B. Practical							
1	CSE3251	Software Engineering Lab	0	0	3	3	1.5
2	CSE3252	Computer Networks Lab	0	0	3	3	1.5
3	XXX3261-XXX3270	Professional Elective-III Lab	0	0	2	2	1

	CSE3261 CSE3262 CSE3263 CSE3264 CSE3265 CSE3266 CSE3267 IOT3261	Image Processing Lab Enterprise Application in Java EE Lab Machine Learning Lab Compiler Design Lab Cloud Computing Lab NoSQL Database with MongoDB Lab Real Time & Embedded System Lab Big Data and IOT Lab					
Total Practical			**0**	**0**	**8**	**8**	**4**

C. Sessional							
1	CSE3293	Term Paper and Seminar	0	0	4	4	2
2	CSE3295	Project-I	0	0	4	4	2
Total Sessional			**0**	**0**	**8**	**8**	**4**
Total of Semester			**18**	**0**	16	**34**	**24**

4th Year 7th 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
	CSE4131 CSE4132 CSE4133 CSE4134 CSE4135 CSE4136 DSC4133	Soft Computing Cryptography & Network Security Approximation Algorithms Information Retrieval Distributed Databases Mobile Computing Introduction to Deep Learning					
3	XXX4141-XXX4150	Professional Elective-V	3	0	0	3	3

	CSE4141 CSE4142 CSE4143 CSE4144 CSE4145 CSE4146 CSE4147 CSE4148	Natural Language Processing Quantum Computing Pattern Recognition Computational Complexity Social Network Analysis Computer Vision Web Development with Node and Express Agile Methodology					
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	CSE4191	Industrial Training / Internship	**-**	**-**	**-**	**-**	**2**
2	CSE4195	Project-II	0	0	6	6	3
Total Sessional			**0**	**0**	6	6	**5**
Total of Semester			**15**	**0**	**6**	**21**	**20**

4th Year 8th Semester

Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
1	CSE4295	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

1st Semester

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

Course Outcome:

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

PHY1001.1: Understand physical systems in terms of their modeling 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 behavior of a particle under the influence of different potential.
PHY1001.6: Understand conservative systems based on their particle and wave nature.

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- tunneling.

Reference

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.
11. 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 Outcome:

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.

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.

Module I: [10L]

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, rectifier output without and with filters. 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, transfer characteristics of OPAMP, CMRR, slew rate, offset error voltages and current, concept of virtual ground

Basic circuits using OPAMP: Comparator, inverting and non-inverting amplifiers, voltage follower, 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 Outcome:
After going through this course, the students will be able to:

HUM1002.1: Appreciate the essential complementarily 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 fulfillment among them.

Module 1: [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 Fulfill the Basic Human Aspirations.
Continuous Happiness and Prosperity – the Basic Human Aspirations.

Module 2: [10L] Harmony in the Family and Society

The self as a social being starting with the family as the smallest unit—the process of socialization.
Development of the self in relation to the society – Cooley's and Mead's theories of socialization.
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 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 3: [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, Institutionalizing Ethics.
Vision for the Universal Human Order, Exploring Systems to fulfill Human Endeavors.

Module 4: [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.

References

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 Laboratory					
Course Code: PHY1051					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Course Outcome:

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

PHY1051.1: Apply practical knowledge using the experimental methods to correlate with the Physics theory.
PHY1051.2: Understand the usage of electrical and optical systems for various measurements.
PHY1051.3: Apply the analytical techniques and graphical analysis to the experimental data.
PHY1051.4: Understand measurement technology, usage of new instruments and real time applications in engineering studies.
PHY1051.5: Evaluate intellectual communication skills and discuss the basic principles of scientific concepts in a group.
PHY1051.6: Construct the new idea by compiling their knowledge and can develop the new or improve the methodology.

Minimum six experiments have to be performed taking at least one from the following groups.

Optics Group

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 specific rotation of sugar solution by using a Polarimeter.
4. Determination of wavelength of the given laser source by diffraction method.

Electricity & Magnetism Group

1. Determination of the magnetic field using circular current carrying coil.
2. Determination of dielectric constant of a given dielectric material.
3. Determination of Hall coefficient of a semiconductor by four probe method.
4. Determination of unknown resistance using Carey Foster's bridge

Quantum Physics Group

1. Determination of Stefan-Boltzmann constant.
2. Determination of Planck constant using photocell.
3. Determination of Rydberg constant by studying Hydrogen spectrum.
4. Determination of Band gap of semiconductor.

Miscellaneous Group

1. Determination of Young's modulus of elasticity of the material of a bar by the method of flexure
2. Determination of modulus of rigidity of the material of a rod by static method
3. Determination of rigidity modulus of the material of a wire by dynamic method
4. Determination of coefficient of viscosity by Poiseulle's capillary flow method

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

Course Outcome:

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

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-meters etc.
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 Practices					
Course Code: MEC1051					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	1	**0**	**3**	**4**	**2.5**

Course Outcome:

After successfully completing this course the 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.

(i) Lectures: [13L]

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)

Text/Reference Books:

1. Hajra Choudhury S. K., Hajra Choudhury A. K. and Nirjhar Roy S. K., "Elements ofWorkshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters andpublishers 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" PearsonEducation, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice HallIndia, 1998.
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:

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

MEC1052.1: Visualizethe basic concept of engineering drawing.

MEC1052.2: Use engineering drawing tools (conventional / modern tools).

MEC1052.3: Apply the various standards and symbols followed in engineering drawing.

MEC1052.4: Implement the concept of projections used in engineering graphics.

MEC1052.5: Relate the concept of sections to determine its true shape.

MEC1052.6: Execute the concept of isometric projections.

Lecture Plan [13L]

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

Laboratory hours (39 hours)

Module 1: Introduction to Engineering Drawing (3 hours)

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

Module 2: Orthographic Projections (9 hours)

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

Module 3: Projections of Regular Solids (6 hours)

Those axes inclined to both the Planes- Auxiliary Views.

Module 4: Sections and Sectional Views of Right Angular Solids (3 hours)

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Sectional orthographic views of geometrical solids.

Module 5: Isometric Projections (6 hours)

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.

Module 6: Overview of Computer Graphics (3 hours)

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.

Module 7: Customization& CAD Drawing (3 hours)

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.

Module 8: Annotations, layering & other functions (3 hours)

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.

Module 9: Demonstration of a simple team design project that illustrates (3 hours)

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

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 Vaish Wanar, 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.

2nd 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:

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

CHM1001.1: Knowledge acquisition of bulk properties of materials and understanding of reaction processes using thermodynamic considerations.

CHM1001.2: Conception of energy conversion and its importance in clean energy scenario, the operating principles for batteries, fuel cells and the materials and reactions involved there in, their applications as sustainable energy devices, particularly in automobiles sectors to reduce environmental pollution.

CHM1001.3: Analytic view of microscopic chemistry in terms of atomic structure, molecular orbital and intermolecular forces to reinforce strong background on materials science and engineering.

CHM1001.4: Rationalize periodic trends of elements to explain various physico - chemical properties.

CHM1001.5: Understanding of the spectrum of electromagnetic radiation used for exciting different molecular energy levels in various spectroscopic techniques.

CHM1001.6: Knowledge of stereochemistry and conception of the mechanism of major chemical reactions involved in synthesis of drug molecules.

MODULE 1: [9L]

Thermodynamics

The 1st and 2nd laws of thermodynamics and thermodynamic functions like free energy, work function and entropy; Carnot cycle, Joule-Thomson effect, Gibbs-Helmholtz equation; Chemical Potential, Gibbs- Duhem Equation and Clausius-Clapeyron Equation.

Electrochemical Cell

Generation of electromotive force in electrochemical cells and application of Nernst equation; Electrode potentials and the redox reactions; Cell configuration and half cell reactions; Standard Hydrogen Electrode, Reference electrode, evaluation of thermodynamic functions; Electrochemical corrosion. Electrochemical Energy Conversion: Primary & Secondary batteries, Fuel Cells.

MODULE 2: [9L]

Molecular Structure

Molecular geometry, Hybridization, Ionic, dipolar and van Der Waals interactions; Molecular Orbital Theory and its application indiatomic molecule; Pi-molecular orbital of unsaturated system; Band structure of solids, intrinsic and extrinsic semiconductors and the role of doping on band structures. **5L**

Periodic Properties

Effective nuclear charge, penetration of orbitals; variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes; ionization energies, electron affinity and electro-negativity, polarizability, oxidation states, coordination numbers and geometries; hard-soft acid base theory.

MODULE 3: [9L]

Atomic structure and Wave Mechanics

Brief outline of the atomic structure, wave particle duality, Heisenberg uncertainty principle; Introduction to quantum mechanics, Schrodinger wave equation for particle in one dimensional box.

Spectroscopic Techniques & Applications

Electromagnetic spectrum: Interaction of EMR with matter; Principle and applications of Fluorescence & Phosphorescence, UV-Visible, Infrared and NMR spectroscopy

MODULE 4: [9L]

Stereochemistry

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

Organic reactions and synthesis of drug molecules

Introduction to reaction mechanism: substitution, addition, elimination and oxidation, reduction reactions. Synthesis of commonly used drug molecules.

TEXT BOOKS

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

REFERENCE BOOKS

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

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

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

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.

Module I: [10L] Basic Probability
Random experiment, Sample space and events, Classical and Axiomatic definition of probability, Addition and Multiplication law of probability, Conditional probability, Bayes' Theorem, Random variables, General discussion on discrete and continuous distributions, Expectation and Variance, Examples of special distribution: Binomial and Normal Distribution.

Module II: [10L] Basic Numerical Methods
Solution of non-linear algebraic and transcendental equations: Bisection Method, Newton-Raphson Method, Regula-Falsi Method. Solution of linear system of equations: Gauss Elimination Method, Gauss-Seidel Method, LU Factorization Method, Matrix Inversion Method. Solution of Ordinary differential equations: Euler's Method, Modified Euler's Method, Runge-Kutta Method of 4th order.

Module III: [10L] Basic Graph Theory
Graph, Digraph, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Sub-graph, Walk, Path, Circuit, Euler Graph, Cut sets and cut vertices, Matrix representation of a graph, Adjacency and incidence matrices of a graph, Graph isomorphism, Bipartite graph, Dijkstra's Algorithm for shortest path problem. Definition and properties of a Tree, Binary tree and its properties, Spanning tree of a graph, Minimal spanning

tree, Determination of spanning trees using BFS and DFS algorithms, Determination of minimal spanning tree using Kruskal's and Prim's algorithms.

Module IV: [10L] Laplace Transformation

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

References:

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.

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

Module I: [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 preprocessor (macro, header files), command line arguments.

Arrays and Pointers:

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

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

Module 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 completion of the course, 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.

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, Dhanpat Rai
5. Fundamental of Electrical Engineering, Rajendra Prasad, PHI, Edition 2005.
6. Basic Electrical Engineering, Nath & Chakraborti

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 completion of the course, 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 environment
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, Mc Graw Hill Education(India) Pvt. Ltd..Chennai,2018
3 Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011

Reference Books:

1. 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 Laboratory					
Course Code: CHM1051					
Contact hrs 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

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.

Experiments

1. Estimation of iron using KMnO4 self indicator.
2. Iodometric estimation of Cu2+.
3. Determination of Viscosity.
4. Determination of surface tension.
4 Adsorption of acetic acid by charcoal.
5. Potentiometric determination of redox potentials.
6. Determination of total hardness and amount of calcium and magnesium separately in a given water sample.
7. Determination of the rate constant for acid catalyzed hydrolysis of ethyl acetate.
8. Heterogeneous equilibrium (determination of partition coefficient of acetic acid in n-butanol and water mixture).
9. Conductometric titration for the determination of strength of a given HCl solution against a standard NaOH solution.
10. pH-metric titration for determination of strength of a given HCl solution against a standardNaOH solution.
11. Determination of chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

Reference Books

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

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 Laboratory					
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

Module I: [6hrs]

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: [6hrs]

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: [6hrs]

- 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: [6 hrs]

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

3rd Semester

Course Title: Data Structures & Algorithms					
Course Code: CSE2101					
Contact hrs 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.

Module 1: [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 2: [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 3: [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 4: [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).

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

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

Course Title: Operating Systems					
Course Code: CSE2102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

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

CSE2102.1: Develop knowledge about the importance of computer system resources and the role of operating system in their management policies and algorithms.
CSE2102.2: Understand processes and its management policies and scheduling of processes by CPU.
CSE2102.3: Acquire an understanding of the need of process synchronization, evaluate the requirement for process synchronization and coordination handled by operating system.
CSE2102.4: Analyze the memory management and its allocation policies and compare different memory management approaches.
CSE2102.5: Use system calls for managing processes, memory, file system etc.
CSE2102.6: Be familiar with different storage management policies and storage technologies.

Module 1: [7L]

Introduction: Operating system functions, OS Architecture (Monolithic, Microkernel, Layered, Hybrid), Different types of O.S. (batch, multi-programmed, time-sharing, real-time, distributed, parallel).
System Structure: Computer system operation, Operating system structure (simple, layered, virtual machine), O/S services, System calls.
Protection & Security: Goals of protection, Domain of protection, Access matrix and its representation, Threats and system security.

Module 2: [13L]

Processes and Threads: 7 state process model, Process scheduling, Operations on processes, Inter-process communication, Threads overview, Benefits of threads, User and kernel threads.
CPU Scheduling: Scheduling criteria, Preemptive & non-preemptive scheduling, Scheduling algorithms (FCFS, SJF, RR, Priority, Multi-level queue, Multi-level feedback queue), Comparative study of the algorithms, Multi-processor scheduling.
Process Synchronization: Background, Critical section problem, Software solution – Peterson and Bakery algorithm, Synchronization hardware, Semaphores, Classical problems of synchronization.

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

Module 3: [9L]

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

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

Module 4: [7L]

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

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

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.

2. 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.

Course Title: Digital Circuit Design					
Course Code: ECE2002					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes

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

ECE2102.1: Students will learn about the Binary Number system and minimization of logic expression using different methods.

ECE2102.2: Students will design different Arithmetic Combinational circuits like Adder, Subtractor.

ECE2102.3: Students will be able to design Multiplexer, De-Multiplexer, Decoder, Encoder, etc and learn about applications

ECE2102.4: Students will be able to design Sequential Circuits such as flip flops and perform inter conversion of them.

ECE2102.5: Students will design various types of Registers and Counters Circuits using Flip-Flops (Synchronous, Asynchronous, Irregular, Cascaded, Ring, Johnson).

ECE2102.6: Students will learn basic gates using CMOS logic and analyze different memory systems including RAM, ROM, EPROM, EEROM, etc.

Module1: [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 POS forms; Minimization of logic expressions by algebraic method; Karnaugh-map method, Quine-McCluskey method (3 & 4 variables).

Module 2: [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 3: [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 4: [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. Anand kumar-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

Paper Name: Probability and Statistics (B. Tech. CSE, AI & ML, DS)					
Paper Code: MTH2102					
Contact hours per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Course Outcomes:

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

MTH 2102.1: Compare and contrast different interpretations of probability theory and take a stance on which might be preferred.
MTH 2102.2: Formulate predictive models to tackle situations where deterministic algorithms are intractable.
MTH 2102.3: Understand the application of probability and statistics in different real-world problems.
MTH 2102.4: Summarize data visually and numerically.
MTH 2102.5: Assess data-based models.
MTH 2102.6: Apply tools of formal inference.

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.

Text Books:

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.

References:

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.

Paper Name: DISCRETE MATHEMATICS					
Paper 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, contra positive, 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 $\boldsymbol{n}$ $(\mathbb{Z}_{\boldsymbol{n}})$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.

Text books

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 (2^{nd} 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 Mc Graw 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: 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 1: [6L]

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

Module 2: [6L]

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

Module 3: [6L]

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

Module 4: [6L]

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

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 Title: Data Structures and Algorithms Lab					
Course Code: CSE2151					
Contact hrs 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.

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 expression.

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 and iii) exit operations.

Home Assignment

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

i) insert, ii) delete and 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 and 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) and 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 and iii) post-order.

Display the elements while traversing.

Day 9: Searching

Lab Assignment

WAP to implement,

i) Linear Search and 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 and 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 and 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

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

Course Name: Operating Systems Lab					
Course Code: CSE2152					
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

CSE2152.1: Understand and implement basic services and functionalities of the operating system using system calls.

CSE2152.2: Will be able to describe and create user defined processes.
CSE2152.3: Understand the benefits of thread over process and implement them.
CSE2152.4: Synchronization programs using multithreading concepts.
CSE2152.5: Use modern operating system calls and synchronization libraries in software to implement process synchronization.
CSE2152.6: Implementation of Inter-process communication using PIPE.

1. **Shell programming:** Creating a script, making a script executable, shell syntax (variables, Conditions, control structures, functions and commands).
2. **Process:** starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
3. **Signal:** signal handling, sending signals, signal interface, signal sets.
4. **Semaphore:** programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).
5. **POSIX Threads:** programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)
6. **Inter-process communication:** pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO).

TextBooks

1. Your Unix: The Ultimate Guide, Sumitabha Das, MH

Reference Books

1. Beginning Linux Programming, Neil Matthew, Richard Stones, Wrox.

Course Name: Digital Circuit Design Lab					
Course Code: ECE2052					
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:
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 .

ECE2052.4: Design and test combinational circuits.

ECE2052.5: 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.

Course Name: Software Tools Lab					
Course Code: CSE2153					
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

CSE2153.1: Learn the concept and use of an integrated development environment.
CSE2153.2: Identify different compilation options in gcc and develop static and shared libraries.
CSE2153.3: Analyze the errors in a code using gdb and valgrind.
CSE2153.4 Analyse a code with code coverage testing and know how to speed up execution using profiling tools.
CSE2153.5: Compose a makefile and use the make utility to automate compilations.
CSE2153.6: Understand the need for version control and learn effective methods to do the same.

1. **CodeLite IDE [Code::Blocks]:** Learn to use CodeLite IDE for writing C/C++ programming languages.
2. **Compiling with gcc:** Learn all the command line options for compiling C programs in the Unix environment using gcc.
3. **Static and Dynamic Library:** Understand the linking phase of a C program by creating and using static and dynamic libraries.
4. **Debugging with gdb:** gdb is the standard C/C++ debugger to debug your code. Learn to interact with gdb directly via a shell, or use a graphical interface provided by CodeLite IDE.
5. **Memory profiling with valgrind:** Learn to use valgrind which is a critical tool for helping one to find memory leaks in the program: malloc without free, accessing an array outside its bounds, etc.
6. **Code coverage testing with gcov:** Learn about good testing using gcov to make sure the tests are exercising all the branches in the code.
7. **Runtime profiling with gprof:** Learn about using gprof which is a very useful profiling tool for speeding up execution speed of a program: it will show where your program is spending most of its time, so one can know about the most important code to optimize
8. **Makefile:** Learn how to use makefile on Unix to properly build an executable.
9. **Git for sharing files and version control:** Learn to setup a repository so that it can sync your local with that on the server. Learn to use CVS for version controlling.

Textbooks

1. The Definitive Guide to GCC, William von Hagen, 2nd Edition, 2006, Apress.
2. Linux Debugging and Performance Tuning: Tips and Techniques, Steve Best, Pearson Education,1st Edition, 2006.

Reference Books

1. Version control with Git, Jon Loeliger,1st Edition,2009, O'Reilly.
2. The Art of Debugging with GDB, DDD, and Eclipse, Norman Matloff, Peter Jay Salzman, 2008.

4th 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.

Module 1: [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 2: [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 3: [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 4: [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.

Module 1: [10L]
Basics of Computer Organization: Basic organization of the stored program computer and operation sequence for execution of a program, Von Neumann & Harvard Architecture. RISC vs. CISC based architecture.

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

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

Module 2: [11L]

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

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

Module 3: [10L]

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

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

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

Module 4: [9L]

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

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

Textbooks

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

Reference Books

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

Course Name: Object Oriented Programming					
Course Code: CSE2203					
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:
CSE2203.1: Understand the principles and philosophies of object-oriented programming paradigm: encapsulation, abstraction, polymorphism, reuse through inheritance and dynamic binding.
CSE2203.2: Compare the procedural and object oriented paradigm with concepts of input/output streams, abstraction through classes, polymorphism through overloaded functions, class and objects.
CSE2203.3: Understand parameter passing techniques, value(C, Java) vs. reference(C++), errors and exceptions, OOP concepts of classes, initialization, cleanup, polymorphism techniques.
CSE2203.4: Apply multithreading techniques to improve performance.
CSE2203.5: Demonstrate OOP concepts of member access control, class relationships, inheritance and component, dynamic binding, abstract class, virtual inheritance, generic types and functions
CSE2203.6: Analysis and Design of Object Oriented Software with ability to model and develop solutions using C++ and Java implementing object-oriented paradigm concepts.

Module 1: [10L]

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 2: [10L]

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 3: [10L]

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 4: [11L]

Package and Interface. Exception Handling: Types of Exception Classes, Use of Try & Catch with Throw, User-defined Exceptions Classes. Threads, Communication and Synchronization of Threads: Multithreading, Thread Lifecycle, Thread Priorities, 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.

Course Title: Algebraic Structures					
Course Code: MTH2201					
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:

MTH2201.1: Describe the basic foundation of computer related concepts like sets, POsets, lattice and Boolean Algebra

MTH2201.2: Analyze sets with binary operations and identify their structures of algebraic nature such as groups, rings and fields.

MTH2201.3: Identify and compare homomorphic and isomorphic structures.

MTH2201.4: Compare even permutations and odd permutations, abelian and non-abelian groups, normal and non-normal subgroups and units and zero divisors in rings.

MTH2201.5: Adapt algebraic thinking to design programming languages.

MTH2201.6: Explore the applications of finite group theory to computational problem.

Module I: [10L] Relations on Set and their Representation:

Set theory. Binary relations defined on sets, Matrix representation of relations. Mapping with classification. Equivalence relation and equivalence classes. partially ordered sets (POset). Hasse diagram. Maximal, minimal, greatest and least elements in a POset. Lattices and their properties. Distributive and complemented lattices. Principle of duality.

Module II: [10L] Group Theory – I

Cartesian product, Binary operation, Composition Table. Group, elementary theorems on groups. Permutations, Product of permutations, Group property of permutations, Cyclic permutation, Transposition, Even and Odd permutations, Proposition regarding permutations, Alternating Groups.

Module III: [10L] Group Theory – II

Order of an element of a group, Properties of the order of an element of a group. Subgroups, some basic theorems on subgroups. Cyclic group, Cosets, Lagrange's theorem, Fermat's Little

Theorem(statement only). Normal subgroup, some basictheorems on normal subgroup. Quotient group.

Module IV: [10L] Morphisms, Rings and Fields

Homomorphism and Isomorphism of groups, some basic theorems, Automorphism group. Rings, some elementary properties of a ring. Ring with unity, Characteristic of a ring, Ring with zero divisors, Sub-ring, Integral domain, Field, Division Ring or Skew Field, Ideal. (Emphasis should be given on examples and elementary properties.)

Text Books

1. Discrete Mathematics and Its Applications – Kenneth H. Rosen.
2. Higher Algebra – S. K. Mapa.
3. Abstract Algebra – M. K. Sen, S. Ghosh, P. Mukhopadhyay.

Reference Books

1. Discrete Mathematics – T Veerarajan.
2. Introduction to Discrete Mathematics via Logic and Proof –Calvin Jongsma.
3. Advanced Highe rAlgebra – J. G. Chakraborty and P. R. Ghosh.
4. A First Course in Abstract Algebra – J. B. Fraleigh.
5. Contemporary Abstract Algebra – J. A. Gallian.

Course Name: Microprocessors & Microcontrollers					
Course Code: AEI2205					
Contact Hours per week:	L	T	P	Total	Credit points
	2	0	0	2	2

Course Outcomes

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

AEI2205.1: Understand the architecture of 8-bit microprocessor (8085A).
AEI2205.2: Develop the skill in program writing of 8-bit microprocessor (8085A).
AEI2205.3: Understand the architecture of 16 bit microprocessor (8086).
AEI2205.4: Learn the skill in program writing for 16-bit microprocessor (8086).
AEI2205.5: Understand the architecture and develop the skill in program writing of microprocessor 8051 and PIC16F877.
AEI2205.6: Understand the architecture and operation of programmable peripheral device 8255A.

Module 1: [6L]

Introduction to 8-bit microprocessor: 8085 microprocessor internal architecture, 8085 pin configuration, Software instruction set, timing diagram of the instructions.

Module 2: [7L]

Addressing modes and Assembly language programming: Interrupts of 8085 processor: classification of interrupts, Programming using interrupts. Counter and Time delay, Support IC chips 8255- Block diagram, pin configuration, mode of operation, control word(s) format and Interfacing with Microprocessors.

Module 3: [7L]

Introduction to 8086/8088 Architecture: Architecture, memory segmentation, pin configuration, clock generator, instruction set, addressing modes and assembly language programming of 8086/8088, interrupts.

Module 4: [6L]

Introduction to microcontrollers: Intel MCS-51 family features, 8051 architecture, pin configuration, I/O ports and memory organization; Instruction set and basic assembly language programming, interrupts and returns; Interrupts, timer/counter and serial communication.

Brief introduction to PIC microcontroller (16F877): Architecture, pin details, memory layout etc.

Textbooks

1. Microprocessor architecture, programming and applications with 8085/8085A, Ramesh S. Gaonkar, Wiley eastern Ltd.
2. Fundamental of Microprocessor and Microcontrollers, B. Ram, Dhanpat Rai Publications.
3. Microprocessors and Microcontrollers, N. Senthil Kumar, M. Saravanan, S. Jeevanathan, Oxford Publications.
4. 8085 Microprocessor and its Applications, A. Nagoor Kani, Third Edition, TMH Education Pvt. Ltd.

Reference Books

1. The 8051 Microcontroller and Embedded. Systems. Using Assembly and C. Muhammad Ali Mazidi, Janice Gillispie Mazidi. Rolin D. McKinlay, Second Edition, Pearson Publication.
2. Advanced Microprocessors and Peripherals, A.K.Ray, K.Bhurchandi, TMH Education Pvt. Ltd.
3. PIC Microcontroller and Embedded. Systems. Using Assembly and C. Muhammad Ali Mazidi, Janice Gillispie Mazidi. Rolin D. McKinlay, Pearson Publication.
4. Design with PIC Microcontroller, John Peatman, Pearson Publication.

Course Name: 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 Sort using Divide and Conquer approach. Check the running time for each of the n! combinations or input sequences of a particular set of integers to observe the best, worst and average cases.
3. Implement Heapsort algorithm. Check the running time for each of the n! combination or input sequences of a particular set of integers to observe the best, worst and average cases.
4. **Dynamic Programming:** Find the minimum number of scalar multiplications needed for chain of Matrices.
5. **Dynamic Programming:** Implement Bellman Ford Algorithm to solve Single Source shortest Path problem of a graph.
6. **Dynamic Programming:** Implement Floyd-Warshall Algorithm to solve all pair shortest path for a graph.
7. **Dynamic Programming:** Solve 0/1 Knapsack problem using dynamic problem.
8. **Dynamic Programming:** Solve Longest Common Subsequence problem using dynamic problem.
9. **Greedy method:** Implement Dijkstra's algorithm to find 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: Object Oriented Programming Lab					
Course Code: CSE2253					
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

CSE2253.1: Apply object-oriented principles or features in software design process to develop C++ and Java programs for real life applications.
CSE2253.2: Reduce the complexity of procedural language by employing operator overloading, inheritance and exception handling techniques for developing robust and reusable software.
CSE2253.3: Develop programs using stream classes for various I/O operations and design concurrent programs using threads to maximize the use of processing power.
CSE2253.4: Design applications for text processing using String class and develop user interactive applications using event handling.
CSE2253.5: Analyse the difference between two object-oriented programming languages C++ and Java.

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, String Builder 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.

Course Name: Microprocessors & Microcontroller Lab					
Course Code: AEI2255					
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

AEI2255.1: Understand and apply different instructions of 8085 microprocessor.
AEI2255.2: Understand and apply different instructions of 8086 microprocessor.
AEI2255.3: Understand and apply different instructions of 8051 microcontroller.
AEI2255.4: Interface 8085A microprocessor with different input and output devices (e.g., LEDs, seven segments displays ADC, DAC, and stepper motor etc.).
AEI2255.5: Interface 8086A microprocessor/ 8051 microcontroller with different input and output devices (e.g., LEDs, seven segments displays ADC, DAC, and stepper motor etc).

Detailed Syllabus

1. Familiarization with 8085A trainer kit components with the process of storing and viewing the contents of memory as well as registers. Repeat the above all using 8085A Simulator.
2. Study of programs using basic instruction set (data transfer, load/store, arithmetic, logical) of 8085A microprocessor.
3. Programming using 8085A trainer kit/simulator for:
   a) Copying and Shifting block of memory
   b) Packing and unpacking of BCD numbers
   c) Addition/Subtraction of two 8-bit Hex numbers
   d) Addition of 16-bit Hex numbers.
   e) BCD Addition
   f) Binary to ASCII conversion
   g) String Matching and Sorting.
4. Familiarization of 8086 microprocessor trainer kit/simulator using data transfer, load/store, arithmetic and logical instructions.
5. Write assembly language programs (ALP) using 8086 microprocessor trainer kit /simulator on the following:
   a) Finding the largest/ smallest number from an array
   b) Arranging numbers in ascending/descending order
   c) Shifting a block of data from one memory location to another
   d) Addition of a series of BCD numbers
   e) String matching
6. Interfacing of 8085A through 8255A PPI/ 8051 Microcontroller with switches and LEDs to perform
   a) Display operation
   b) Blinking operation and
   c) Scrolling operation

7. Interfacing with seven segment displays through 8-bit latch (e.g., 74LS373) using- a) 8085A trainer kit, b) 8086A trainer kit through 8255A PPI.
8. Interfacing of ADC, DAC, and Stepper motor with 8085A/8086 microprocessor trainer kit.

References

Assignment sets to be provided.

Course Name: Design Thinking and Idea Lab (CSE)					
Course Code: CSE2254					
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:

CSE2254.1: Understand the definition, objectives, and relevance of design thinking.
CSE2254.2: Get familiarized with the stages of the design process: Empathize, Define, Ideate, Prototype, and Test.
CSE2254.3: Learn how to apply the design thinking process for developing innovative products.
CSE2254.4: Propose innovative product designs and choose appropriate frameworks, strategies, and techniques during prototype development.
CSE2254.5: 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 mockup 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

1. Den Dekker Teun, “Design Thinking”, Wolters-Noordhoff 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.

DETAILED SYLLABUS

3rd Year

5th Semester

Course Title: Database Management Systems					
Course Code: CSE3101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	0	0	4	4

Course Outcomes:

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.

Text books:

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

Course Name: Formal Language & Automata Theory					
Course Code: CSE3002					
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

CSE3002.1: Recall the basic characteristics of various types of machines, languages and grammars.
CSE3002.2: Compare different computational models, languages and grammars based on their properties and behaviors.
CSE3002.3: Apply formal mathematical methods to prove properties of languages, grammars, and automata.
CSE3002.4: Apply the knowledge of theory of computation to an engineering application (e.g., designing the compilers).
CSE3002.5: Classify formal languages and evaluate whether a language/grammar belongs to a given type or not.
CSE3002.6: Design automata for given languages/grammars. Generate languages/grammars for a given automaton and Construct grammars for languages and vice versa.

Module 1: [11L]
Fundamentals: Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram, Design of sequence detector (Application of concept of Automata to sequential circuit design), Introduction to finite state model.

Finite state machine: Definitions, capability & state equivalence, kth- equivalence concept. Minimization of FSM, Equivalence between two FSM's, Limitations of FSM; Moore & Mealy machine and their conversion.

Finite Automata: Deterministic finite automaton (DFA) and non-deterministic finite automaton (NFA). Transition diagrams and Language recognizers; Application of finite automata, NFA with ϵ transitions - Significance, acceptance of languages. Design of DFA/ NFA for given languages.

Conversions and Equivalence: Equivalence between NFA with and without ϵ transitions. NFA to DFA conversion.

Module 2: [12L]

Introduction to Formal Languages and Grammars: Chomsky Classification of grammar: unrestricted, context sensitive, context free and regular grammar. Grammar Formalism: Right linear and left linear grammars, Regular grammar, Regular Languages, Regular sets. Regular expressions, identity rules, Problems on Regular expressions. Arden's theorem statement, proof and applications. Constructing finite Automata for a given regular expressions, Regular string accepted by NFA/DFA. Pumping lemma of regular sets. Closure properties of regular sets (proofs not required). Equivalence between regular grammar and FA.

Module 3: [13L]

Context free grammar: Introduction to Context free grammars, Derivation/ parse trees, Sentential forms, Right most and leftmost derivation of strings, ambiguity in context free grammars, various problems on CFG. Minimization of Context Free Grammars: Removal of useless, null and unit productions. Chomsky normal form and Greibach normal form. Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (proofs omitted). Closure property of CFL, Ogden's lemma & its applications.

Push Down Automata: Push down automata, Definition and design of PDA. Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, conversion from one to another. (Proofs not required). Introduction to DCFL and DPDA.

Module 4: [12L]

Turing Machine: Introduction to Turing Machine, Definition, Model. Design of TM for different languages, TM as language accepter. TM as transducers. Computable functions. Languages accepted by a TM, recursively enumerable and recursive languages. Diagonalization method. Church's hypothesis, counter machine. Types of Turing machines (proofs not required). Universal Turing Machine. Decidability, Undecidability, Various Undecidable problems like Post's Correspondence Problem (PCP), Turing Machine Halting Problem, Ambiguity of Context Free Grammars etc.

Textbooks

1. Introduction to Automata Theory Language and Computation, Hopcroft H.E. and Ullman J. D., Pearson Education.
2. An Introduction to Formal Languages and Automata, Peter Linz, Jones and Bartlett Publishers.
3. Introduction to the Theory of Computation, Sipser Michael. Cengage Learning.
4. Theory of Computer Science, Automata Languages and computation", Mishra and Chandrashekaran, 2nd edition, PHI.

Reference Books

1. Switching & Finite Automata, ZVI Kohavi, 2nd Ed., Tata McGraw Hill.
2. Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
3. Introduction to languages and the Theory of Computation, John C Martin, TMH.
4. Elements of Theory of Computation, Lewis H.P. &Papadimitrou C.H. Pearson.

Course Name: Electronic Design Automation					
Course Code: ECE3106					
Contact Hours per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**2**

Course Outcomes

After completion of the course, students will be able to

ECE3106.1: Getting exposure to VLSI Design Cycle, Process nodes and Design Challenges.
ECE3106.2: Designing of Industry Standard CMOS Combinational Digital Gates.
ECE3106.3: Designing of Industry Standard TG based Sequential Digital Gates.
ECE3106.4: Learning High Level Synthesis in EDA flow.
ECE3106.5: Learning Logic Synthesis in EDA flow and Verilog RTL.
ECE3106.6: Learning Physical Place and Route in EDA flow.

Module 1: [8L]

VLSI Circuits & Physical Layout: MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics, Delay & Noise, CMOS NAND, NOR and Combinational Logic Circuits, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop, Setup and Hold Time.

CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm.

Module 2: [4L]

VLSI Design Methodology: Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node.

VLSI Design Cycle, Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT.

Module 3: [6L]

EDA: High level Synthesis and Logic Synthesis: High level Synthesis EDA Flow, Control and Data Flow Graph, Scheduling, Allocation, Binding, Verilog RTL.

Combinational Logic Optimization: Binary Decision Diagram (BDD), OBDD, ROBDD, Technology Mapping: Pattern DAG, Subject DAG, Sequential Logic Optimization.

Module 4: [6L]

EDA: Physical Design Automation: Physical Layout Automation EDA Flow, Partitioning: KL Algorithm, Floor-planning cost function, Floorplans Placement, Global Routing: Steiner Tree, Maze Routing. Detailed Routing: Channel Routing, Horizontal Constraint Graph, Vertical Constraint Graph, Cyclic Constraint, Left-edge Algorithm.

Textbooks

1. Principles of CMOS VLSI Design, A Systems Perspective, Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000.
2. Algorithms for VLSI Physical Design Automation, N. Sherwani, Kluwer Academic Publishers (3rd edition).

Reference Books

1. CMOS Digital Integrated Circuits, Analysis and Design, Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition).
2. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition), Neil Weste, David Harris, Ayan Banerjee. Pearson.
3. Digital Integrated Circuit, Design Perspective, M. Rabaey, Prentice-Hall.
4. VLSI Design and EDA TOOLS, Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, Scitech Publications (India) Pvt. Ltd., 2011.
5. Algorithms for VLSI Design Automation, Gerez, Wiley, 2011.

LIST OF COURSES FOR PROFESSIONAL ELECTIVE–I

Paper Code	Paper Name
CSE3131	Computer Graphics and Multimedia
CSE3132	Data Mining & Knowledge Discovery
CSE3133	Web Technologies
CSE3134	Graph Algorithms
CSE3135	Randomized Algorithms

Course Name: Computer Graphics & Multimedia					
Course Code: CSE3131					
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

CSE3131.1: Compare and study effectiveness of different line and circle drawing algorithms on Raster scan display.
CSE3131.2: Design two-dimensional graphics and apply two dimensional transformations.
CSE3131.3: Design three-dimensional graphics and apply three dimensional transformations.
CSE3131.4: Apply Illumination and color models and apply clipping techniques to graphics.
CSE3131.5: Demonstrate activities and applications of device dependent and independent color models, image representation techniques (raster and random graphics).
CSE3131.6: Understood Different types of Multimedia File Format and demonstrate image, video, text analysis tools and techniques.

Module 1: [10L]

Introduction to computer graphics & graphics systems: Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.

Scan Conversion: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

Module 2: [9L]

2D transformation & viewing: Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines, Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse. Cohen and Sutherland line clipping, Sutherland-Hodgeman Polygon clipping, Cyrus-beck clipping method.

Overview of 3D Transformation and Viewing: 3D transformations: translation, rotation, scaling & other transformations. rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, viewport clipping, 3D viewing.

Module 3: [8L]

Curves: Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.

Hidden surfaces: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal -geometry.

Color & shading models: Light & color model; interpolative shading model; Texture.

Module 4: [9L]

Text: Different types of text representation, Hypertext, text representation formats.

Audio: Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI.

Video: Analogue and Digital Video, Recording Formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals, Video Capture.

Animation: Techniques of 2D & 3D animation, formats of Animation

Image and Video Database: Image representation, segmentation, similarity-based retrieval, image retrieval by color, shape and texture; indexing- k-d trees, R-trees, quad trees.

Textbooks

1. Computer Graphics (C version 2nd Ed.), Hearn, Baker, Pearson education.

Reference Books

1. Schaum's outlines Computer Graphics (2nd Ed.), Z. Xiang, R. Plastock, TMH.
2. Computer Graphics: Principles and Practice, 2nd Edition, Foley, Vandam, Feiner and Hughes, Pearson Education, 2003.
3. Mathematical Elements for Computer Graphics (2nd Ed.), D. F. Rogers, J. A. Adams, TMH.
4. Multimedia: Computing, Communications & Applications, Ralf Steinmetz and Klara Nahrstedt, Pearson Ed.
5. Multimedia Communications, Fred Halsall, Pearson Ed.
6. Multimedia Fundamentals: Vol. 1- Media Coding and Content Processing, Ralf Steinmetz and Klara Nahrstedt, PHI.
7. Principles of Multimedia, Ranjan Parekh, TMH.
8. Introduction to Computer Graphics and Multimedia, A Mukhopadhyay, A Chattopadhyay, Vikas Publication.

Course Name: Data Mining & Knowledge Discovery					
Course Code: CSE3132					
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

CSE3132.1: Learn and understand basic knowledge of data mining and related models.
CSE3132.2: Understand and describe data mining algorithms.
CSE3132.3: Understand and apply Data mining algorithms.
CSE3132.4: Suggest appropriate solutions to data mining problems.
CSE3132.5: Analyze data mining algorithms and techniques.
CSE3132.6: Perform experiments in Data mining and knowledge discovery using real-world data.

Module 1: [9L] Introduction and Rule-based Classification

What is Data Mining? Why do we need data mining? Data Mining System - Architecture and Processes. Challenges in Data Mining.

Decision Tree: General approach for solving a classification problem, Decision Tree Induction, Over-fitting, Pruning.

Rule-based Classification: How a rule-based classifier works, rule-ordering schemes, how to build a rule-based classifier, direct and indirect methods for rule extraction.

Module 2: [9L] Advanced Classification Techniques

Bayes' Classifier: Bayes' theorem, Naïve Bayes' classifier. Support Vector Machines (SVM): Maximum margin hyper-planes, Linear SVM: separable case, non-separable case, Non-linear SVM.

Module 3: [9L] Ensemble Methods, Association Rule Mining

Ensemble Methods: Bagging, Boosting, Random Forests, Association Rule Mining: Introduction, Frequent itemset generation, (Apriori principle, candidate generation and pruning), Rule generation, Compact representation of frequent itemsets, FP-growth algorithm, Sub-graph mining.

Module 4: [9L] Cluster Analysis

Introduction: Motivations, objectives and applications of clustering. Different types of clustering.
Partitional Clustering: K-means, Bisecting K-means, PAM.
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

2. Introduction to Data Mining, P. N. Tan, M. Steinbach and V. Kumar, Pearson Publishers.
3. Pattern Recognition and Machine Learning, First Edition, C. Bishop, Springer, 2006.
4. Neural Networks and Learning Machines, Third Edition, S. Haykin, PHI Learning, 2009.
5. Pattern Classification, Second Edition, R. Duda, P. Hart and D. Stock, Wiley-Interscience, 2000.

Course Name: Web Technologies					
Course 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 1: [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 2: [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 3: [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 4: [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

1. Web Technology: A Developer's Perspective, N. P. Gopalan and J. Akilandswari, PHI Learning, Delhi, 2013.
2. Internetworking Technologies, An Engineering Perspective, Rahul Banerjee, PHI Learning, Delhi, 2011.
3. Java Servlets and JSP, Murach's.
4. Java for the Web with Servlets, JSP, and EJB, Budi. Kurniawan.
5. Cryptography and Network security, William Stallings.
6. Introduction to Web Technology, Pankaj Sharma, S K Kataria and Sons; Reprint 2013 edition.

Course Name: Graph Algorithms					
Course Code: CSE3134					
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

CSE3134.1: Learn the advanced concepts and key features of Graph algorithms.

CSE3134.2: Understand the algorithmic approach to Graph related problems.
CSE3134.3: Explain and analyze the major graph algorithms.
CSE3134.4: Employ graphs to model engineering problems, when appropriate.
CSE3134.5: Defend and argue the application of the specific algorithm to solve a given problem.
CSE3134.6: Synthesize new algorithms that employ graph computations as key components, and analyze them.

Module 1: [8L] Connected components and transportation related graph problems

Representation of graphs, Sub graphs, Degree Sequences, Connectivity, Cut-Vertices and Bridges, Digraphs; Depth First Search. DFS for undirected graphs, non-separable components and directed graphs. Topological Sorting. Strongly connected components, Tarjan's algorithm for strongly connected components; Eulerian tours, Characterization. De Bruijn Sequences. Eulerian Digraphs ; Hamiltonian graphs and travelling salesman problem. Exponential-time dynamic programming for the TSP, approximation algorithms and the approximation ratio, MST-doubling heuristic, Christofides' heuristic.

Module 2: [10L]

Flow networks and Bipartite graphs: Max flow min cut theorem, max flow algorithms and their applications; Min cost max flow algorithm, their applications; Bipartite graphs, formulating bipartite maximum matching as a flow problem.

Matching and covering related graph problems: Matchings, stable marriage problem, Gale-Shapley algorithm for stable marriage problem; Hopcroft–Karp algorithm. Using matchings to find vertex covers and independent sets.

Module 3: [10L] Graph Coloring, Planarity and longest path

Graph coloring, greedy coloring, Maximal clique; Brooks theorem, the greedy algorithm, the Welsh-Powell bound, critical graphs, chromatic polynomials, girth and chromatic number, Vizing's theorem.

Introduction to planarity of the graph, duality of the planar graph and max cut of the planar graph. Euler's formula, Kuratowski's theorem, toroidal graphs, 2-cell embeddings, graphs on other surfaces; Longest path Problem, hardness and heuristic for solution.

Module 4: [8L]Random graphs and Selected topics:

Random graphs and probabilistic methods; Dominating sets, the reconstruction problem, intersection graphs, interval graphs, perfect graphs, Chordal graphs; Maximum Clique-Minimum coloring problem in interval graph; Algorithms for independent set, clique and vertex coloring in Chordal graphs.

Textbooks

1. Graph Algorithms, Shimon Even and Guy Even, Cambridge University Press, 2nd Edition 2012.
2. Introduction to Graph Theory, Douglas B. west, Prentice Hall, 2001.
3. Graph Theory and Its Applications, Jonathan L. Gross and Jay Yellen.
4. Advanced graph algorithms, T. Kloks.

Reference Books

1. Graph Theory, R. Diestel, Springer-Verlag, 2nd edition, 2000.
2. Modern Graph Theory, Bela Bollobas, Springer, 1998.
3. Algorithm Design, Jon Kleinberg and Eva Tardos.

Course Name: Randomized Algorithms					
Course Code: CSE3135					
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

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 variouscombinatorial 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-1: [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-2: [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-3: [9L]
Applications of probability in combinatorics: balls and bins, probabilistic methods, random graphs.

Module-4: [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.

LIST OF COURSES FOR PROFESSIONAL ELECTIVE–II

Paper Code	Paper Name
CSE3141	Artificial Intelligence
CSE3142	Introduction to Data Analysis with Python and R
CSE3143	Advanced Operating Systems

Course Name: Artificial Intelligence					
Course Code:CSE3141					
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:

CSE3141.1: 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.
CSE3141.2: Comprehend the importance of knowledge as far as intelligence is concerned and the fundamentals of knowledge representation and inference techniques.
CSE3141.3: Apply this knowledge so that it can be used to infer new knowledge in both certain and uncertain environment
CSE3141.4: Apply various AI searching algorithms, like state-space search algorithm, adversarial search algorithm, constraint satisfaction search algorithm as and when required.
CSE3141.5: 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.
CSE3141.6: Design and evaluate the performance of a heuristic applied to a real-world situation.
Module 1: [9L]

Introduction: Definition of AI, Intelligent Behavior, Turing Test, Typical AI Problems, Various AI Approaches, Limits of AI.

Introduction to Intelligent Agents: Agents & environment, Agent Architecture, Agent Performance, Rational Agent, Nature of Environment, Simple Reflex Agent, Goal Based Agent, Utility Based Agent.

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

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

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

Module 2: [9L]

Informed Search Methods: Basic Principles, Heuristics, A* Search and its properties, Admissible & Consistent heuristic, Iterative deepening A* (IDA*) and AO* search, Local Search Techniques – Hill climbing & Simulated Annealing, Comparison with other methods

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

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

Module 3: [9L]

Knowledge Representation & Predicate Logic: Syntax & Semantics of FOPL, Representation of facts using FOPL, Clauses, Resolution, Unification methods of inference, Default & Non-Monotonic reasoning.

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

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

Other Representational Formalism: Inheritable knowledge, Semantic network, Inference in Semantic network, Extending Semantic Network, Frames, Slots as objects.

Module 4: [9L]

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

Learning: Overview, Taxonomy of learning system, various learning models, learning rules, 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.

Textbooks

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.
3. Artificial Intelligence: A new Synthesis, Nils J. Nilsson, Morgan Kaufmann Publishers, Inc.
4. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India.

Course Name: Introduction to Data Analysis with Python and R					
Course Code: CSE3142					
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:

CSE3142.1: Understand the basics of the Python Programming Language.
CSE3142.2: Remember and understand about basic Python data structures.
CSE3142.3: Apply NumPy and pandas libraries in Python.
CSE3142.4: Understand the basics of the R Programming Language.
CSE3142.5: Remember and understand about R data structures.
CSE3142.6: Apply Python and R in building solutions to basic data analysis problems.

Module 1: [9L]

Data Science Introduction: Facets of data. The Big Data Ecosystem and Data Science. The Data Science Process. Retrieval, cleansing, integrating and transforming data. Exploratory Data Analysis. Data Visualization.

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 2: [9L]

Manipulating Strings: Regular Expressions in Python.

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

Effective Python: Pythonic Thinking and Writing Better Pythonic Code.

Module 3: [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 4: [9L]

R Programming Introduction: R UI, R-Studio, Functions, Arguments, Scripts.

R Data Structures: Vectors, Attributes, Matrices, Arrays, Classes, Factors, Lists, Data Frames.

Computing with R: Using R Operations: Selection, Modification, Logical sub-setting.

Handling Missing Information, Conditionals, Scoping rules, Assignment, Evaluation, Loops: For, While, Repeat, Efficiency Issues. R Code: Debugging, Profiling, Simulations with R code.

Textbooks

1. Introduction to Programming Using Python, Y. Daniel Liang. Pearson, 2017.
2. Python for Data Analysis, Wes McKinney, O'Reilly, 2017.
3. Hands on Programming in R, Garrett Grolemund, O'Reilly.

Reference Books

1. Python for Everybody, Charles Severance, 2016.
2. Advanced R, Hadley Wickham. CRC Press, 2015.
3. R for Data Science, Hadley Wickham and Garrett Grolemund, 2017.
4. Introducing Data Science, D. Cielen, A. Meysman, M. Ali, Manning Publishers, 2018.
5. Effective Python, Brett Slatkin, Pearson, 2015.

Course Name: Advanced Operating System					
Course Code: CSE3143					
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:

CSE3143.1: Describe operating system structures and communication protocols.
CSE3143.2: Understand key mechanisms and models for distributed systems including logical clocks, causality, vector timestamps, distributed hash tables, consistent global states, election algorithms, distributed mutual exclusion, consistency, replication, fault tolerance, distributed deadlocks, recovery, agreement protocols
CSE3143.3: Learn how to design and implement distributed algorithms.

CSE3143.4: Understand the high-level structure distributed file systems.

CSE3143.5: Design various areas of research in distributed systems.

CSE3143.6: Understand the basic concepts of real time operating system.

Module 1: [9L]

Introduction to Distributed System: Introduction, Examples of distributed system, Resource sharing, Challenges

Operating System Structures: Review of structures: monolithic kernel, layered systems, virtual machines. Process based models and client server architecture; The micro-kernel based client-server approach.

Communication: Inter-process communication, Remote Procedure Call, Remote Object Invocation, Tasks and Threads. Examples from LINUX, Solaris 2 and Windows NT.

Module 2: [9L]

Theoretical Foundations: Introduction. Inherent Limitations of distributed Systems. Lamport's Logical clock. Global State: Chandy, Lamport's Global State Recording Algorithm.

Distributed Mutual Exclusion: Classification of distributed mutual exclusion algorithm. Non-Token based Algorithm: Lamport's algorithm, Ricart-Agrawala algorithm. Token based Algorithm: Suzuki-Kasami's broadcast algorithm. A comparative performance analysis of

different algorithms with respect to Response time, Synchronization delay, Message traffic, Universal performance bound.

Distributed Deadlock Detection: Deadlock handling strategies in distributed systems. Control organizations for distributed deadlock detection. Centralized and Distributed deadlock detection algorithms: Completely Centralized algorithms, path pushing, edge chasing, global state detection algorithm.

Module 3: [9L]

Distributed file systems: Issues in the design of distributed file systems: naming, writing policy, Cache consistency, Availability, Scalability and Semantics. Use of the Virtual File System layer. Case Studies: Sun NFS, The Sprite File System, CODA, The x-Kernel Logical File System.

Distributed Shared Memory: Architecture and motivations. Algorithms for implementing DSM: The Central-Server Algorithm, The Migration Algorithm, The Read-Replication Algorithm, The Full-Replication Algorithm. Memory Coherence. Case Studies: IVY, Clouds.

Distributed Scheduling: Issues in Load Distributing: Load, Classification of Load Distribution, Load Balancing vs Load Sharing, Preemptive vs Non-preemptive; Components of a load distribution; Stability.

Module 4: [9L]

Real Time operating Systems: Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task

communication, task synchronization, Definition and types of RTOS; A reference model of Real Time System- Processors, Resources, Temporal parameters, Periodic Task; Aperiodic Task, Sporadic Task; Commonly used approaches to Real Time Scheduling - Clock driven, event driven, Priority based scheduling- Inter-process communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE.

Textbooks

1. Advanced Concepts in Operating Systems, Singhal Mukesh & Shivaratri N. G., TMH.
2. Distributed Operating Systems, Tanenbaum, A. S., Prentice Hall India.
3. Distributed Operating Systems Concepts and Design, Pradeep K. Sinha, Prentice Hall India.
4. Real-Time Systems, Jane W. S. Liu, Pearson Education.

Reference Books

1. Distributed Systems Principles and Paradigms, Andrew S. Tanenbaum and Maarten Van Steen, PHI.
2. Modern Operating Systems, 2nd Edition Tanenbaum, A. S., Prentice Hall 2001.

3. Concurrent Systems, 2nd Edition, Bacon, J., Addison Wesley 1998.
4. Applied Operating Systems Concepts, 1st Edition, Silberschatz, A., Galvin, P. and Gagne, G., Wiley 2000.
5. Distributed Systems: Concepts and Design, 3rd Edition, Coulouris, G. et al, Addison Wesley 2001.

Course Name: Database Management Systems Lab					
Course 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, Elmasri Ramez and Novathe Shamkant, Benjamin Cummings Publishing Company.

Reference Books

1. SQL, PL/SQL: The Programming Language of Oracle (With CD-ROM) (English) 4th Revised Edition, Ivan Bayross, BPB Publications.

Course Name: Electronic Design AutomationLab					
Course Code: ECE3151					
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

ECE3151.1: Learn Industry Standard Frontend and Synthesis CAD Tool (Xilinx Vivado).
ECE3151.2: Learn Industry Standard Verilog RTL Behavioral and Structural Design.
ECE3151.3: Learn Logic Synthesis and Place and Route using FPGA Flow.
ECE3151.4: Learn Industry Standard Backend CAD Tool (Mentor Graphics).
ECE3151.5: Design CMOS Combinational Digital Gates
ECE3151.6: Design CMOS/TG Sequential Digital Gates.

List of Experiments:
1. Familiarities with Xilinx Vivado Front end and Synthesis CAD Tool
2. Verilog RTL Design and Testing of Digital Gates (INV, NAND, NOR, MUX, AOI, OAI …)
3. Verilog RTL Design and Testing of Functional Blocks (Adder, Decoder, ALU …)
4. Verilog RTL Design and Testing of Sequential Gates (Latch, Flop …)
5. Verilog RTL Structural Design and Testing of Functional Blocks
6. Verilog RTL Design and Testing for Finite State Machine (Mealy, Moore)
7. Logic Synthesis and P & R using Vivado for FPGA
8. Familiarity with Mentor Graphics Back end CAD Tool
9. CMOS Inverter, NAND, NOR Delay, VTC, Noise Analysis
10. MOS/TG Sequential Design and Analysis

Textbooks

1. Principles of CMOS VLSI Design, A Systems Perspective, Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition.
2. Algorithms for VLSI Physical Design Automation, N. Sherwani, Kluwer Academic Publishers (3rd edition).

Reference Books

1. CMOS Digital Integrated Circuits, Analysis and Design, Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition).
2. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition), Neil Weste, David Harris, Ayan Banerjee. Pearson.
3. Digital Integrated Circuit, Design Perspective, M. Rabaey, Prentice-Hall.
4. VLSI Design and EDA TOOLS, Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, Scitech Publications (India) Pvt. Ltd., 2011.
5. Algorithms for VLSI Design Automation, Gerez, Wiley, 2011.

Course Name: Artificial Intelligence Lab					
Course Code: CSE3171					
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

CSE3171.1: Remember and understand the working principles of PROLOG/ LISP
CSE3171.2: Apply LIST structure of PROLOG as and when required
CSE3171.3: Make use of CUT to the programs as and when required
CSE3171.4: Solve the problems by using accumulator
CSE3171.5: Apply the principles of reasoning and inference to real world problems
CSE3171.6: 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, Saroj Kaushik, New Age International Publishers.

Course Name: **Introduction to Data Analysis Lab**					
Course Code: CSE3172					
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

CSE3172.1: Learn how to write simple programs in Python using conditional branching, iteration, functions, and recursion.
CSE3172.2: Execute string manipulation without and with regular expressions in Python and use Python's basic data structures such as Tuple, List, Dictionary, Set.
CSE3172.3: Implement Python programs for input/output using files, exception handling, and object oriented programming.
CSE3172.4: Learn the utility of advanced Python libraries such as Pandas and NumPy.
CSE3172.5: Learn how to write simple programs in R using data frames, conditional branching, iteration, and functions.
CSE3172.6: Apply Python and R programming skills in data analysis problem(s).

Exercises and assignments:

1. Topic 1
    a. Finding the distance between two points whose coordinates are given
    b. Finding the roots of a quadratic equation
    c. Finding the maximum and minimum out of a few numbers given
2. Topic 2
    a. Area of shapes
    b. Finding prime numbers
    c. Interlocking words
3. Topic 3
    a. Palindrome check
    b. Tower of Hanoi
    c. Read from and write to files
4. Topic 4
    a. Differentiating a polynomial
    b. Classes and objects
    c. Finding divisors
5. Topic 5
    a. Phone number check with regular expressions

    b. Password validation with regular expressions
    c. Properties of different quadrilaterals with OOP
6. Topic 6
    a. NumPy arrays and matrices
    b. Applications of Pandas data structures
7. Topic 7
    a. Simple R programs
    b. Applications of different data frames in R
8. Topic 8
    a. Data Analysis Project: Introduction and Data Preprocessing
9. Topic 9
    a. Data Analysis Project: Execution and Conclusions

References

1. Python: https://www.python.org/
2. Python Tutorial: https://www.w3schools.com/python/
3. Intro to R and R Studio: https://openintro.info/stat/labs.php

Course Name: Advanced Operating Systems Lab					
Course Code: CSE3173					
Contact Hours per week:	L	T	P	Total	Credit points
	0	0	2	2	1

Course Outcome

After completion of the course, students will be able to

CSE3173.1: Explain the fundamental concepts of Operating systems like scheduling, memory management, inter-process communications and concurrent programming
CSE3173.2: Discuss the synchronization primitives needed to implement highly concurrent data structures
CSE3173.3: Explain various types of locks used to achieve synchronization of concurrent objects
CSE3173.4: Apply different scheduling algorithm to schedule snapshot of processes queued according to FCFS, SJF, Priority, Round Robin scheduling.
CSE3173.5: Apply various synchronization techniques on linked lists
CSE3173.6: Analyze the performance of sequential and multiprocessor algorithms used for multiprocessor programming.

CPU scheduling

1. Given the list of processes, their CPU burst times and arrival times. Display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.
2. Given the list of processes, their CPU burst times and arrival times. Display/print the Gantt chart for Priority and Round robin. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.

Inter-process Communication

Develop application using Inter-Process Communication using

1. shared memory
2. pipes
3. message queue

Memory Management

1. Implement Memory management schemes like paging and segmentation.
2. Implement Memory management schemes like First fit, Best fit and Worst fit.

Shared Objects and Synchronization

1. The Producer–Consumer Problem
2. The Readers–Writers Problem

Mutual Exclusion and Critical Section

1. lock object
2. The Peterson lock algorithm
3. Filter Lock
4. Lamport's Bakery Algorithm

Concurrent Objects

Develop a lock-based FIFO queue. The queue's items are kept in an array items, where head is the index of the next item to dequeue, and tail is the index of the first open array slot (modulo the capacity). The lock field is a lock that ensures that methods are mutually exclusive. Initially head and tail are zero, and the queue is empty. If enq() finds the queue is full, i.e., head and tail differ by the queue size, then it throws an exception. Otherwise, there is room, so enq() stores the item at array entry tail, and then increments tail. Thedeq() method works in a symmetric way.

Spin Locks and Contention

1. Test-And-Set Locks
2. TAS-Based Spin Locks
3. Queue Locks
4. Array-Based Locks

Monitors and Blocking Synchronization

1. Monitor Locks and Conditions
2. Readers–Writers Locks

Linked Lists: The Role of Locking

1. Coarse-Grained Synchronization
2. Fine-Grained Synchronization
3. Optimistic Synchronization
4. Lazy Synchronization

Reference Books

1. The Art of Multiprocessor Programming, Maurice Herlihy, Nir Shavit, ELSEVIER
2. Beginning Linux Programming, Neil Matthew, Richard Stones, Wrox.
3. Concurrent Programming in Java: Design Principles and Patterns, Doug Lea, Addison Wesley

LIST OF COURSES FOR OPEN ELECTIVE I

Paper Code	Paper Name
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)
MTH3121	Linear Algebra

Subject Name: FUNDAMENTALS OF SENSORS AND TRANSDUCERS					
Course Code: AEI3122					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

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

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

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]

Controlof 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 Outcome:

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 of 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 and cyclic codes.
ECE3123.5: Outline the basics of convolution code, linear algebra, and BCH code.
ECE3123.6: Develop an overall understanding of different types of codes applied to both source and channel end during data transmission

Module-1: 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-2: Error Control code: Linear Block Code [7L]

Block code: Hamming codes Minimum distance, Error detecting and Error-correcting Capabilities of block code.
Linear Block Code: Definition & properties of linear block codes, Matrix description of linear Block codes, Encoding of linear block code, parity check matrix, decoding of a linear block code, Syndrome and Error detection.

Module-3: 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-4: Convolution Codes: [9 L]

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
For convolution 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. Graw Hill

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
Stereo lithography (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 Name: 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 isues 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.

Course Title: Linear Algebra					
Course Code: MTH3121					
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:

MTH3121.1: Explain concepts of diagonalization, orthogonal diagonalization and Singular Value Decomposition (SVD).

MTH3121.2: Discuss basis, dimension and spanning sets.

MTH3121.3: Design Gram-Schmidt Orthogonalization Process and QR decomposition using concepts of inner product spaces.

MTH3121.4: Analyze Least squares solutions to find the closest line by understanding projections.

MTH3121.5: Define linear transformations and change of basis.

MTH3121.6: 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: [10L]

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: [10L]

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: [10L]

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: [10L]

Linear Transformations, kernels and images, The Rank-Nullity Theorem.Matrix representation of a Linear Transformation, Change of Basis, Linear space of linear mappings.

Text Books

1. Linear Algebra and its Applications –Gilbert Strang.
2. Higher Algebra – S. K. Mapa.

Reference Books

1. Linear Algebra – Kenneth M. Hoffman, Ray Kunze.
2. Linear Algebra –Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence.
3. Schaum's Outline of Linear Algebra – Seymour Lipschutz and Marc Lipson.
4. Matrix Computations – Gene H. Golub, Charles F. Van Loan.
5. Linear Algebra A Geometric Approach – S. Kumaresan.

Course Name: Fundamentals of Operating Systems					
Course Code: CSE3121					
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:

CSE3121.1: Understand the underlying technologies and features of memory management and storage management.

CSE3121.2: Understand the various design issues in process management.

CSE3121.3: Apply knowledge of mathematics, science and engineering in the areas of process management, memory management and storage management.

CSE3121.4: Analyze operating system operations, structures.

CSE3121.5: Judge the primitive operations of operating systems.

CSE3121.6: Assemble the concepts learned here which are used in their own field of work.

Detailed Syllabus

Module1 [7L]

Introduction of General Operating System: Introduction: What do OS do? Computer System Organization, Interrupt Driven System, Storage Structure, I/O Structure, Operating System Functions, OS Services, Dual Mode Operations, Kernel, System Calls, Types of System Calls

Types of Operating Systems: Computer System Architecture (Monolithic, Microkernel, Layered, Hybrid), Different types of O.S.(Batch, Multi-programmed, Time-sharing, Real-time, Distributed, Parallel, for Mobile Unit, Single Processor System, Multiprocessor Systems), Virtual Machines, System Boot.

Module2 [9L]

Process Concept: What is process, Operations on Process (Process States), Process Control Block, Process Scheduling, Scheduling Queues,

Cooperating Process: Co-operating Processes, Inter-process Communication. IPC, Examples in IPC, Communication in Client-Server Systems

Threads: Threads, Benefits of Threads, User and Kernel Threads.

CPU Scheduling: Scheduling Criteria, Pre-emptive & Non-pre-emptive Scheduling, Scheduling Algorithms (FCFS, SJF, RR, priority).

Module3 [10L]

Process Synchronization: Critical Section Problem, Critical Region, Synchronization Hardware. Petersons Solution, Classical Problems of Synchronization, Semaphores, Monitors, Synchronization examples, Atomic Transactions.

Deadlock: Deadlocks: System model, Deadlock characterization, Method of handling Deadlock, Deadlock Prevention, Avoidance, Detection, Recovery from deadlock.

Module4 [10L]

Memory Management Strategies: Contiguous Memory Allocation, Paging, Structure of Page Table, Segmentation, Demand Paging, Copy-on-Write, Swapping, Page Replacement, Allocation

of Frames, Thrashing, Memory Mapped Files, Allocating Kernel Memory, Operating System examples.
File Management: File System: File Concept, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection.

Textbooks

1. Silberschatz, P B Galvin, G Gagne, Operating systems, 9th edition/10th edition, John Wiley and sons.

Reference Books:

1. William Stalling, "Operating Systems: Internals and Design Principles", Pearson Education, 1st Edition, 2018.
2. Andrew S Tanenbaum, Herbert BOS, "Modern Operating Systems", Pearson Education, 4th Edition, 2016.

APPENDIX – A

UPDATEDGUIDELINESOF MASSIVE OPEN ONLINE COURSES (MOOCS) SCHEME

(WITHEFFECTFROM2023-2024ACADEMICSESSION)

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 therequiredcreditforB.Tech.degree.StudentshouldsubmitallthecertificatesbeforethelastdateofsubmissionofMOOCsfortheB.Tech.Honoursdegree, 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**Forother MOOCs platforms like Coursera, edX, Udemy, Simpilearn etc**

i) Coursesof4 weeks to 7 weeks: 1 credit point
ii) Courses of 8 weeks to 11 weeks: 2 credit point
iii) Courses of 12 weeks to 15 weeks: 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 8 hours, 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

Point Description for Mandatory Additional Requirement (MAR)

Sl. No.	Name of the Activity	Points	Maximum Points allowed
1	MOOCS (SWAYAM/NPTEL/Spoken Tutorial) (per course)	20	40
2	Tech Fest / Teachers Day / Freshers Welcome		
	(i) Organizer	05	10
	(ii) Participants	03	06
3	Rural Reporting	05	10
4	Tree Plantation (per tree)	01	10
5	Participation in Relief Camps	20	40
6	Participation in Debate/Group Discussion/ Tech quiz	10	20
7	Publication of Wall magazine at Institutional level (magazine/article/internet)	10	20
8	Publication in News paper, Magazine & Blogs	10	20
9	Research Publication (per publication)	15	30
10	Innovative Projects (other than course curriculum)	30	60
11	Blood donation camp		
	(i) Donor	08	16
	(ii) Camp Organizer	10	20
12	Participation in Sports/Games		
	(i) College Level	05	10
	(ii) University Level	10	20
	(iii) District Level	12	24
	(iv) State Level	15	30
	(v) National / International Level	20	40
13	Cultural programme (Dance, Drama, Elocution, Music etc.)	10	20
14	Member of Professional Society	10	20
15	Student Chapter Activities / Seminars		
	(i) Participant	05	20
	(ii) Presentation	10	20
	(iii) Organizer	10	20
16	Relevant industry visit & report	10	20
17	Activities in different clubs at HIT (Photography Club, Cine Club etc.)	05	10
18	Participation in Yoga Camp	05	10
19	Self-Entrepreneurship programme	20	20
20	Adventure sports	10	20
21	Training to under privileged / Physically challenged	15	30
22	Community Service & Allied Activities	10	20
23	Hackathon (State / National Level)		
	(i) Participation in Hackathon	10	20
	(ii) Qualifier for final round (not prize winner) in Hackathon	20	40
	(iii) Prize Winners of Hackathon	30	60

Format for Report Submission

Name :

Department :

Year/Semester :

Title of the Activity :

Date :

Name of the organization :

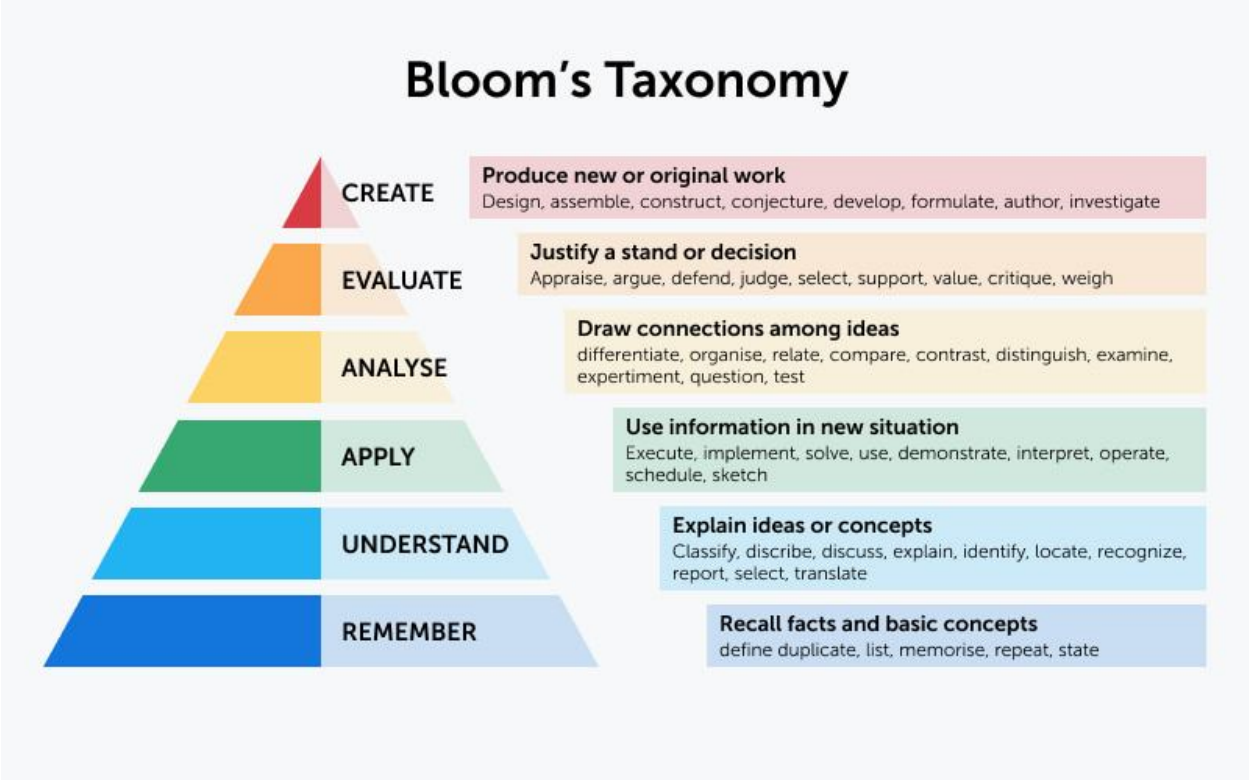
Report :

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