Curriculum and Syllabus [Regulation-25]

Incorporating Guidelines of NEP2020

B.Tech. in Electronics and Communication Engineering

(Effective From 2025-2026 Admission Batch)

JIS College of Engineering

(NAAC 'A' Accredited An Autonomous Institute)

(Affiliated to Maulana Abul Kalam Azad University of Technology)

1st Year 1st Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/ Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC101	Basic Electrical and Electronics Engineering	3	0	0	3	3
2	ENGG	Minor	CS102	Introduction to Artificial Intelligence	2	0	0	2	2
3	SCI	Multidisciplinary	CH101	EngineeringChemistry	2	0	0	2	2
4	SCI	Multidisciplinary	M101	Engineering Mathematics- I	3	0	0	3	3
5	HUM	Value Added Courses	HU105	Constitution of India & Professional Ethics	1	0	0	1	1
6	HUM	Ability Enhancement Course	HU103	Design Thinking & Innovation	1	0	0	2	1
B. PRACTICAL									
1	ENGG	Major	EC191	Basic Electrical and Electronics Engineering Lab	0	0	3	3	1.5
2	ENGG	Minor	CS192	Artificial Intelligence Lab	0	0	3	3	1.5
3	SCI	Skill Enhancement Course	CH191	Engineering Chemistry Lab	0	0	2	2	1
4	ENGG	Skill Enhancement Course	ME193	IDEA LAB Workshop	0	0	3	3	1.5
MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	MC181	Induction Program	0	0	0	0	0	0
Total of Theory, Practical								**23**	**17.5**

1st Year 2nd Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC201	Solid State Device	3	0	0	3	3
2	ENGN	Major	EC202	Circuit Theory and network	3	0	0	3	3
3	SCI	Multidisciplinary	PH201	Engineering Physics	3	0	0	3	3
4	SCI	Multidisciplinary	M201	Engineering Mathematics –II	3	0	0	3	3
5	HUM	Value Added Course	HU201	Environmental Science	2	0	0	2	2
6	HUM	Value Added Course	HU202	Indian Knowledge System	1	0	0	1	1
B. PRACTICAL									
1	ENGG	Major	EC291	Solid State Device Lab	0	0	3	3	1.5
2	ENGG	Major	EC292	Circuit theory and network Lab	0	0	3	3	1.5
3	SCI	Skill Enhancement Course	PH291	Engineering Physics Lab	0	0	3	3	1.5
4	ENGG	Skill Enhancement Course	ME294	Engineering Graphics & Computer Aided Design Lab	0	0	3	3	1.5
5	HUM	Ability Enhancement Course	HU291	Communication & Presentation Skill	0	0	3	3	1.5
C. MANDATORY ACTIVITIES / COURSES									
	Mandatory Course	MC281	NSS/ Physical Activities / Meditation & Yoga / Photography/ Nature Club		0	0	0	0	0
Total of Theory, Practical								**29**	**22.5**

Total Credit in 1st Year- 40

2^{nd} Year 3^{rd} Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC301	EM Theory, Antenna & Propagation	3	0	0	3	3
2	ENGG	Major	EC302	Analog Electronic Circuit	3	0	0	3	3
3	ENGG	Major	EC303	Signals & Systems	3	0	0	3	3
4	ENGG	Minor	CS(EC)301	Data Structure	3	0	0	3	3
5	SCI	Minor	M(EC)301	Numerical Methods	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	EC391	EM Theory & Antenna Propagation Lab	0	0	3	3	1.5
2	ENGG	Major	EC392	Analog Electronic Circuit Lab	0	0	3	3	1.5
3	ENGG	Minor	CS(EC)391	Data Structure Lab	0	0	3	3	1.5
4	HUM	Ability Enhancement Course	HU(EC)391	Technical Seminar Presentation & Group Discussion	0	0	3	3	1.5
C. MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	MC	MC381	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives		0	0	0	0
Total of Theory, Practical								**26**	**20**

2nd Year 4th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC401	Digital Electronics	3	0	0	3	3
2	ENGG	Major	EC 402	Digital Signal Processing	3	0	0	3	3
3	ENGG	Major	EC403	Analog & Digital Communication	3	0	0	3	3
4	ENGG	Minor	IT(EC)401	Database Management System	3	0	0	3	3
5	ENGG	Minor	M(EC)401	Probability and Statistics	3	0	0	3	3
B. PRACTICAL									
1	ENGG	Major	EC491	Digital Electronics Lab	0	0	3	3	1.5
2	ENGG	Major	EC492	Digital Signal Processing Lab	0	0	3	3	1.5
3	ENGG	Major	EC493	Analog & Digital Communication Lab	0	0	3	3	1.5
4	ENGG	Minor	IT(EC)491	Database Management System Lab	0	0	3	3	1.5
C. MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	MC	MC481	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives	0	0	0	0	0
Total of Theory, Practical								**27**	**21**

Total Credit in 2nd Year- 41

3rd Year 5th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC501	Information Theory & Coding	3	0	0	3	3
2	ENGG	Major	EC502	Advanced Microprocessor & Microcontroller	3	0	0	3	3
3	ENGG	Major	EC503	Control System	3	0	0	3	3
4	ENGG	Major	EC504A	Mobile Communication & Network	3	0	0	3	3
			EC504B	Computer Architecture					
			EC504C	RF & Microwave Engineering					
			EC504D	Power Electronics					
5	ENGG	Minor	CS(EC)501A	Object Oriented Programming using JAVA	3	0	0	3	3
			CS(EC)501B	Introduction to Quantum Computing					
			CS(EC)501C	Cloud Computing					
			CS(EC)501D	Operating System					
B. PRACTICAL									
1	ENGG	Major	EC592	Advanced Microprocessor & Microcontroller Lab	0	0	3	3	1.5
2	ENGG	Major	EC593	Control System Lab	0	0	3	3	1.5
3	ENGG	Major	EC594A	Mobile Communication & Network Lab	0	0	3	3	1.5
			EC594B	Computer Architecture Lab					
			EC594C	RF & Microwave Engineering Lab					
			EC594D	Power Electronics Lab					
4	ENGG	Minor	CS(EC)591A	Object Oriented Programming using JAVA Lab	0	0	3	3	1.5
			CS(EC)591B	Introduction to Quantum Computing Lab					
			CS(EC)591C	Cloud Computing Lab					
			CS(EC)591D	Operating System Lab					
5	ENGG	Skill Enhancement Course	IT(EC)591	IT Workshop Lab (SciLab/Python/R/C++)	0	0	4	4	2
6	PRJ	Project		Mini Project	0	0	0	4	2

C. MANDATORY ACTIVITIES / COURSES										
	Mandatory Course	MC	MC581	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives	0	0	0	0	0
Total of Theory, Practical								**35**	**25**

3rd Year 6th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC601	VLSI Design	3	0	0	3	3
2	ENGG	Major	EC602	Computer Network	3	0	0	3	3
3	ENGG	Major	EC603A	Introduction to IoT	3	0	0	3	3
			EC603B	Digital Image Processing					
			EC603C	Drone Technologies					
			EC603D	Advanced Communication					
4	ENGG	Major	EC604A	Adaptive Signal Processing	3	0	0	3	3
			EC604B	Automotive Electronics					
			EC604C	Industrial Automation & Robotics					
			EC604D	EDA					
5	ENGG	Minor	EC605A	Nanotechnology	3	0	0	3	3
			CS(EC)605B	Artificial Intelligence & Machine Learning					
			CS(EC)605C	Software Engineering					
			EE(EC)605D	Renewable Energy and Sustainable Development					
6	HUM	Value Added Course	HU602	Research Methodology and IPR	1	0	0	1	1
B. PRACTICAL									
1	ENGG	Major	EC691	VLSI Design Lab	0	0	3	3	1.5
2	ENGG	Major	EC692	Computer Network Lab	0	0	3	3	1.5
3	ENGG	Major	EC693A	Introduction to IoT	0	0	3	3	1.5
			EC693B	Digital Image Processing Lab					
			EC693C	Drone Technologies Lab					
			EC693D	Advanced Communication Lab					
4	ENGG	Major	EC694A	Adaptive Signal Processing Lab	0	0	3	3	1.5
			EC694B	Automotive Electronics Lab					
			EC694C	Industrial Automation & Robotics Lab					
			EC694D	EDA Lab					
5	PRJ	Project	EC681	Project-I	0	0	0	8	4
C. MANDATORY ACTIVITIES / COURSES									

1	Mandatory Course	MC	MC581	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives	0	0	0	0	0
Total of Theory, Practical								**36**	**26**

Total credit in 3rd year – 51

4th Year 7th Semester

Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC701	Embedded Systems	3	0	0	3	3
2	ENGG	Major	EC702A	IC Technology	3	0	0	3	3
			EC702B	Fiber Optic Communication					
			EC702C	Electric Vehicle Technology					
			EC702D	Introduction to AR/VR					
3	ENGG	Minor	CS(EC)701 A	Data Analytics and Security in IoT	3	0	0	3	3
			CS(EC)701 B	Deep Learning					
			CS(EC)701C	Cyber Security & Cryptography					
			CS(EC)701D	Blockchain Technology					
4	HUM	Skill Enhancement Course	HU(EC)701	Project Management and Finance	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	EC791	Embedded Systems Lab	0	0	3	3	1.5
3	ENGG	Skill Enhancement Course	PR792	Rapid Prototyping Lab	0	0	3	3	1.5
4	PRJ	Project	EC782	Project-II	0	0	0	12	6
Total of Theory, Practical								**29**	**20**

4th Year 8th Semester										
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
B. PRACTICAL									
1	PRJ	Project	EC881	Grand Viva	0	0	0	8	4
2	PRJ	Project	EC882	Internship/Entrepreneurship	0	0	0	8	4
Total of Theory, Practical								20	8

Total Credit in 4th year -28

1st Year 1st Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/ Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC101	Basic Electrical and Electronics Engineering	3	0	0	3	3
2	ENGG	Minor	CS102	Introduction to Artificial Intelligence	2	0	0	2	2
3	SCI	Multidisciplinary	CH101	Engineering Chemistry	2	0	0	2	2
4	SCI	Multidisciplinary	M101	Engineering Mathematics- I	3	0	0	3	3
5	HUM	Value Added Courses	HU105	Constitution of India & Professional Ethics	1	0	0	1	1
6	HUM	Ability Enhancement Course	HU103	Design Thinking & Innovation	1	0	0	2	1
B. PRACTICAL									
1	ENGG	Major	EC191	Basic Electrical and Electronics Engineering Lab	0	0	3	3	1.5
2	ENGG	Minor	CS192	Artificial Intelligence Lab	0	0	3	3	1.5
3	SCI	Skill Enhancement Course	CH191	Engineering Chemistry Lab	0	0	2	2	1
4	ENGG	Skill Enhancement Course	ME193	IDEA LAB Workshop	0	0	3	3	1.5
MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	MC181	Induction Program	0	0	0	0	0	0
Total of Theory, Practical								**23**	**17.5**

Course Name: BASICS ELECTRICAL AND ELECTRONICS ENGINEERING
Course Code: EC101
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Pre-requisite: Basic 12 standard Physics and Mathematics, Concept of components of electric circuit.

Course objective: The objective of this course is to understand the fundamental concepts of electrical & electronic circuits and to apply them in simple electrical & electronic circuit analysis.

Course outcomes:
The Graduates of the B.Tech ECE program will be able to:
CO1: Apply fundamental concepts and laws to explain simple DC & AC electric circuit operations.
CO2: Understand the construction, characteristics, equivalent circuit, and performance parameters of transformers.
CO3: Understand the fundamental properties of semiconductors, including energy band theory, carrier transport mechanisms, and key semiconductor laws and relations.
CO4: Explain the operation and characteristics of diodes, rectifiers, voltage regulators, and waveform shaping circuits.
CO5: Explain the structure, operation, characteristics, biasing techniques, and switching applications of BJTs.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	1	1	-	-	1	1	-	-
CO2	3	2	2	1	1	-	-	1	1	-	-
CO3	3	3	2	1	2	-	-	1	1	-	-
CO4	3	3	3	1	2	-	-	1	2	1	3
CO5	3	3	3	1	2	-	-	1	1	-	1

Course Content:

MODULE 1: Elementary Concepts of Electric Circuits: 8L
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only).

MODULE 2: Transformers: 4L
Transformer: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.

MODULE 3: Fundamentals of Semiconductor Devices: 6L
Introduction to Semiconductor: Concept of energy band diagram; Comparison among metal, insulator, semiconductor; Semiconductors-classifications and Fermi energy level; Charge neutrality and Mass-Action law in semiconductor; Current flow in semiconductor due to drift & diffusion process; Einstein relation.

MODULE 4: PN Junction Diode and its applications: 10L
Principle of operation; V-I characteristics; principle of avalanche & Zener breakdown; VI

characteristics of Zener diode. Working principle of half wave and full wave rectifier; Rectifiers-Average output current and voltage, ripple factor, power conversion efficiency; LC filters; working principle of Zener voltage regulator; Block diagram description of DC power supply; Clipper and Clamper circuit.

MODULE 5: Bipolar Junction Transistors: 8L

PNP and NPN structures; Principle of operation; Ebers-Moll Model; Current gains in CE, CB and CC mode; input and output characteristics; Biasing & Stability Analysis-Concept of Q-point, DC and AC load lines, Fixed Bias, Collector to base Bias & voltage divider bias; BJT as switch; Numerical problems.

Textbooks:

1. A Textbook of Electrical Technology - Volume I (Basic Electrical Engineering) & Volume II (Ac & DC Machines)-B. L Theraja & A.K. Teraja, S. Chad,23rd Edition, 1959

2. D. Chattopadhyay, P.C Rakshit, “Electronics Fundamentals and Applications”, New Age International (P) Limited Publishers, Seventh Edition,2006

3. Basic Electrical & Electronics Engineering by J.B. Gupta, S.K. Kataria& Sons,2013

Reference Books:

1. DC Kulshreshtha, “Basic Electrical Engineering”, TataMcGrawHill,2010.

2. Hughes, “Electrical and ElectronicTechnology”, Pearson Education”, 12th edition, 2016

3. Parker and Smith, “Problems in Electrical Engineering”, CBS Publishers and Distributors, 9th edition, 2018.

Course Name	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**
Course Code	**CS102**
Contact Hours (Period/week)	**2**
Total Contact Hours	**30**
Credit	**2**

Pre-requisite: **Class 12th standard Physics and Mathematics and basic ideas of Computer functionalities.**

Course Objectives:

The objectives of this course are to enable students to

1. Comprehend the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context.
2. Formulate a problem as State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
3. Use the strategies of AI-Heuristics to find acceptable solutions avoiding brute- force techniques.
4. Design AI-Frameworks for Inferencing based on knowledge base.
5. Analyze the effectiveness of AI-Inferencing Model in offering solutions to the respective problem.

Course Outcomes (COs):

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

CO1	**Understand and explain** the fundamental concepts of **Knowledge Representation** and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context for further exploration leading towards lifelong learning.
CO2	**Identify** and **formulate** an engineering problem primarily to fit a State-Space Exploration Framework or an Inferencing **Model/Agent** Design Framework within the scope of Artificial Intelligence paradigm.
CO3	**Explore** relevant literature and **apply** the concept of Heuristic Techniques of Artificial Intelligence to **solve** problems.
CO4	**Develop** Inferencing Models for **proposing** solutions to the problems of Artificial Intelligence.
CO5	**Implement** Inferencing Models of Artificial Intelligence through **developing** feasible algorithms and **investigate** their effectiveness by **analyzing** their performances in solving the relevant problems.

CO–PO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
CO1	3	2	-	-	-	-	-	-	-	-	3
CO2	2	3	-	-	-	-	-	-	-	-	-
CO3	2	2	3	2	-	-	-	-	-	-	-
CO4	2	2	2	3	-	-	-	-	-	-	2
CO5	2	2	3	3	2	-	-	-	-	-	2

Course Contents:

Module 1: Introduction to Artificial Intelligence (3 L)

Why AI • Definition of AI • Goals of AI • History and evolution of AI • Types of AI: Narrow, General, Super • Human vs Artificial Intelligence • Applications of AI in various domains • AI for social good

Module 2: Intelligent Agents and Logic-Based Thinking (8 L)

Intelligent systems • Agents and environments • Decision making using rules and logic • Symbolic AI concepts • Propositional Logic: Knowledge Representation and Inference using Propositional Logic • Predicate Logic: Knowledge Representation, Inference and Answer Extraction using First Order Predicate Logic

Module 3: Overview of AI Branches and Perception (8 L)

Machine learning • Deep learning • Natural language processing • Computer vision • Expert systems • Fuzzy logic • Evolutionary algorithms • Reinforcement learning • Planning and scheduling • Human-AI collaboration

Module 4: **Basics of Machine Learning (6 L)**

What is machine learning • AI vs ML • Types of learning: supervised, unsupervised • Concept of dataset, features, and labels • ML model and prediction flow • Common ML applications • Introduction to decision trees (concept only) • ML pipeline overview.

Module 5: **Applications and Ethics of AI (5 L)**

AI in robotics and automation • AI-enabled smart applications • Industry 4.0 and intelligent systems • AI in different sectors: healthcare, agriculture, transport, education, etc. • Human- AI teamwork • Basics of AI ethics: bias, fairness, privacy • Career opportunities and future scopes in AI.

Textbook:

Saptarsi Goswami , Amit Kumar Das , Amlan Chakrabarti - **AI for Everyone: A Beginner's Handbook for Artificial Intelligence (AI),** Pearson**.**

Rich, E., Knight, K and Shankar, B. 2009. **Artificial Intelligence**, 3rd edition, Tata McGraw Hill. Russell , S. and Norvig , P. 2015. **Artificial Intelligence - A Modern Approach**, 3rd edition, Prentice Hall.

Reference Books:

Reema Thareja, **Artificial Intelligence**: Beyond Classical AI, Pearson.

Patterson , **Introduction to Artificial Intelligence and Expert Systems,** Pearson.

Course Name: ENGINEERING CHEMISTRY
Paper Code: CH101
Total Contact Hours: 24
Credit: 2
Prerequisites: 10+2 standard Chemistry and Mathematics.

COURSE OBJECTIVE

- Understand the basic principles of atomic structures and periodic properties of elements, different engineering materials, advanced polymers.
- Apply the knowledge of free energy, energy storage device and semiconductors to design environment friendly and sustainable devices.
- Apply the concept of corrosion and fuel to improve its efficacy and application for industrial purpose.
- Analyze the organic reaction with the structure of organic molecules by applying the knowledge of different spectroscopic techniques.
- Evaluate the electrical, optical, and structural properties of semiconductors to analyze their potential applications in modern electronic and energy devices

COURSE OUTCOME

CO1. Able to understand the basic principles of atomic structures and periodic properties of elements, different engineering materials, advanced polymers.
CO2. Able to apply the knowledge of free energy, energy storage device and semiconductors to design environment friendly and sustainable devices.
CO3. Able to apply the concept of corrosion and fuel to improve its efficacy and application for industrial purpose.
CO4. Able to analyze the organic reaction with the structure of organic molecules by applying the knowledge of different spectroscopic techniques.
CO5. Able to evaluate the electrical, optical, and structural properties of semiconductors to analyze their potential applications in modern electronic and energy devices.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	-	-	-	-	-	2
CO2	3	3	3	3	-	-	2	-	-	-	2
CO3	3	3	-	-	-	-	3	-	-	-	3
CO4	3	3	3	2	-	-	3	-	-	-	3
CO5	3	3	3	3	2	-	-	-	-	-	2

COURSE CONTENT

Module 1

Quantum Properties of Atoms (4 L)

Schrodinger Wave Equation (time independent – basic principles only), de Broglie Equation, Heisenberg Uncertainty Principle, Quantum Numbers, Effective nuclear charge, Slater's rule, penetration of orbitals, variations of orbital energies in the periodic table, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, oxidation properties.

Chemistry of materials (2L)

Semiconductor-Based Memory Materials (Si & Ge) [Introduction, Properties and role of Si & Ge), Intensive & Extensive semiconductor

Module II

Chemical Thermodynamics (5L)

1^{st} & 2^{nd} Law of Thermodynamics, Tendency for maximum randomness, Carnot Heat Engine [Derivation], Entropy characteristics, Mathematical explanation & physical significance of Entropy, Entropy change of ideal gas for isothermal reversible process, Gibbs free Energy Function, Standard free Energy, Criterion of spontaneity.

Electricity production through chemical reactions (2L)

Electrochemical Cell, writing of cell notation, free energy and EMF, Criterion of spontaneity in terms of Cell, Nernst equation (only expression, no derivation) and applications, calculation of EMF of a cell, calculation of single electrode potential, calculation of Kc, calculation of Kc from G^0.

Working principle and applications of Lithium-ion batteries

Module III

Polymers for Engineering Applications (3L)

Polymers and their classifications (based on origin, chemical structure, polymeric structure, tacticity and molecular forces), Commercially important polymers: Synthesis and applications of Bakelite, nylon 6,6, HDPE & LDPE

Conducting polymers –Types examples and applications.

Biodegradable polymers –definition, example and uses

Industrial Chemistry (3L)

Types of corrosion, Electrochemical theory of corrosion, rusting of iron, comparison of chemical & electrochemical corrosion. [Mechanism excluded]

Factors affecting the rate of corrosion; nature of metal (physical state, purity, position in Galvanic series) & environment.

Corrosion control: Cathodic protection, anodic protection, Inorganic coatings.

Classification of Fuel (LPG, CNG, BIOGAS), Calorific value, Octane number, Cetane number, HCV, LCV. [Definition only]

Module IV

Organic Reactions & synthesis of drugs (3L)

Acidity and basicity comparison of organic compounds(acids, alcohols & amines), Nucleophilic Substitution reaction and Electrophilic Addition reactions, Markonikov's rule, peroxide effect, Synthesis of Paracetamol & Aspirin and uses.(Name reactions are not in syllabus)

Spectroscopy (2L)

Electromagnetic spectrum, Lambert-Beer Law, Finding of λ max value & concentration of the unknown solution, Applications of UV-VIS spectroscopy, Chromophores & Auxochromes.

Applications of IR spectroscopy, Fingerprint region

Suggested Text Books

- Chemistry –I, Gourkrishna Das Mohapatro
- A text book of Engineering Chemistry, Dr. Rajshree Khare
- Engineering Chemistry, U. N. Dhar
- Physical Chemistry, P.C. Rakshit

Reference Books

- Engineering Chemistry, Jain & Jain
- Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishna
- Text book of Engineering Chemistry, Jaya Shree Ani reddy

Course Name: ENGINEERING MATHEMATICS - I
Paper Code: M101
Contact (L: T: P): 3 : 0 : 0
Total Contact Hours: 36
Credit: 3

Prerequisites:

The students to whom this course will be offered must have the understanding of (10+2) standard algebraic operations, coordinate geometry, and elementary calculus concepts including limits, continuity, differentiation, and integration.

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in matrix algebra and calculus. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1. Apply linear algebra methods to perform matrix operations, classify matrix structures, solve systems of linear equations, and compute eigenvalues and eigenvectors in engineering contexts.
CO2. Apply differential and integral calculus to evaluate and approximate the behavior of single-variable and multivariable real-valued functions relevant to engineering scenarios.
CO3. Analyze the properties of eigenvalues and eigenvectors to assess matrix diagonalizability and interpret linear transformations using the Cayley-Hamilton theorem in engineering systems.
CO4. Analyze single-variable and multivariable real-valued functions using differential and integral calculus to model and interpret complex behavior in engineering applications.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	1
CO3	3	3	1	1	-	-	-	-	-	-	2
CO4	3	3	1	1	-	-	-	-	-	-	2
M 101	**3**	**2.5**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**

Course Content:

Module I: Liner Algebra (11L)

Echelon form and normal (canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigenvalues and eigenvectors; Diagonalization of matrix, Cayley-Hamilton theorem.

Module II: Single Variable Calculus (5L)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Taylor's series.

Module III: Multivariable Calculus (Differentiation) (13L)

Function of several variables; Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function; Jacobian; Maxima and minima of functions of two variables.

Module IV: Multivariable Calculus (Integration) (7L)

Double Integral, Triple Integral; Change of order in multiple integrals; Line Integral, Surface Integral, Volume Integral. Change of variables in multiple integrals.

Text Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Reference Books:

1. Guruprasad, S. A text book of Engineering Mathematics-I, New age International Publishers.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
5. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
6. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
7. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
8. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
9. Bronson, R., Schaum's Outline of Matrix Operations. 1988.
10. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.

Paper Name: **CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS**
Paper Code: HU105
Contact: 1:0:0
Credit: 1
Total Lectures: 12

Prerequisites:
Basic knowledge (10+2 level) of the Indian Constitution and moral science.

Course outcome: On completing this course the student will be able to

CO1: Identify, define and understand the significance of the Constitution of India, its spirit and values and the fundamental rights and duties as a responsible citizen.
CO2: define and discover core ethical concepts, the basic perception of profession, and professional ethics that shape the ethical behavior of an engineer.
CO3: identify, examine and apply codes of engineering ethics, engineers' social responsibilities and industrial standards and ethical dilemmas.
CO4: consider, correlate and appraise ethical leadership and principles in addressing gender issues, concerns of IPR and industrial responsibilities.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	-	-	-	-	-	-	-	2	-	-	2
CO 2	-	-	-	-	-	-	3	2	-	-	2
CO 3	-	-	-	-	-	2	3	2	-	-	2
CO 4	-	-	-	-	-	2	3	3	-	-	2

<u>Corse Content:</u>

Module 1: **2L**
Preamble : Salient Features, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliament -Powers and Functions –Executive- President -Governor - Council of Ministers.

Module 2: **3L**
Introduction to Ethical Thinking; what is Ethics, Work ethics; Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success.

Module 3: **4L**

Engineering Ethics, Ethical theories: a brief overview; utilitarianism, deontology, virtue ethics.
Professional Codes, Codes of professional ethics-Moral dilemmas, and moral autonomy- Internal ethics of business: whistle blowing, conflicts of interest, Job discrimination, and Exploitation of Employees; Social and ethical responsibilities of technologists: Responsibilities towards Customers, shareholders, employees – Social Audit.

Case Studies: Bhopal Gas Tragedy, Chernobyl (linking ethics to real-world failures).

Module 4: **3L**
Business ethics, ethical decision-making frameworks - Impact of ethics on business policies and strategies- Characteristics of ethical leaders; fostering integrity in teams; Addressing occupational crime, discrimination, and gender-based issues in workplaces-Intellectual property rights (IPR), Plagiarism and Academic Misconduct.

Text Books:
1.Durga Das Basu. *Introduction to the Constitution of India*. 27th ed. New Delhi: Lexis Nexis, 2024.
2. R.S Naagarazan. *A Textbook on Professional Ethics and Human Values*. New Age International (P) Limited, 2022.
3. N. Subramanian. *Professional Ethics.* New Delhi: Oxford University Press, 2017.
4. A N Tripathi, *Human Values*. New Delhi: New Age Publishers, 2019.
5. S. K. Chakraborty. *Values and Ethics for Organizations: Theory and Practices*. New Delhi: Oxford University Press, 1997.

Reference Books:
1.O. C. Ferrell, John Friaedrich and Linda Ferrell. *Business Ethics: Ethical Decision Making and Cases.* New Delhi: Cengage India, 2024.
2.Charles Fledderman. *Engineering Ethics*. 3rd ed. New Delhi: Pearson Education, 2007.
3.Dinesh G. Harkut and Gajendra R. Bamnote. *Professional Ethics for Engineers*. Chennai: Notion Press, 2023.
4.U.C.Mathur, *Corporate Governance and Business Ethics*: *Text and Cases*. Chennai: Macmillan, 2012.
5. Fernando. A. C., K. P. Muralidheeran and E. K. Satheesh. *Business Ethics – An Indian Perspective*. New Delhi: Pearson Education, 2019.

Course Title: Design Thinking and Innovation
Course Code: HU103
Contact Hour: **(L-T-P):** (2-0-0), **Class Hours / Week: 02**
Total class hours: 30
Credit: 01

Prerequisites:
For a course on the Basics of Design Thinking, students should ideally possess basic computer skills, communication abilities, problem-solving aptitude, critical thinking, introductory knowledge of Sustainable Development Goals, curiosity, and openness to new ideas, as well as basic understanding of mathematics, technology, and manufacturing processes.

However, even if these prerequisites are not satisfied, the faculty will cover them in the first few classes.

An awareness of 21st-century skills, including creativity and collaboration, is also beneficial.

These prerequisites aim to provide a foundation, and any gaps in knowledge will be addressed by the instructor early in the course.

Course Objective:
The objective of this Course is to provide new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products and services which are useful for a student in preparing for an engineering career.

Course Outcomes (COs): Upon completion of the course, students shall be able to

CO1: Analyze emotional experience and expressions to better understand stakeholders while designing innovative products through group brainstorming sessions.

CO2: Generate and develop design ideas through different technique

CO3: Develop new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing any innovative products using facility in AICTE IDEA LAB

CO-PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	-	2	2	-	2	3	1	-	-
CO2	1	2	3	3	3	-	2	3	-	3	2
CO3	1	3	3	3	3	2	2	3	-	2	2

Module	Content	Hour
Module1	**Basics of Design Thinking:** Definition of Design Thinking, Need for Design Thinking, history of Design Thinking, Concepts & Brainstorming, 2X2 matrix, 6-3-5 method, NABC method;	3
Module2	**PROCESS OF DESIGN: Understanding Design thinking** Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – MVP or Prototyping. Stages of Design Thinking Process (explain with examples) – Empathize (Methods of Empathize Phase: Ask 5 Why / 5W+H questions, Stakeholder map, Empathy Map, Peer observation, Trend analysis). Define (Methods of Define Phase: Storytelling, Critical items diagram, Define success). Ideate (Brainstorming, 2X2 matrix, 6-3-5 method, NABC method). Prototype (Types of prototypes - Methods of prototyping - Focused experiments, Exploration map, Minimum Viable Product). Test (Methods of Testing: Feedback capture grid, A/B testing).	6
Module3	**Tools for Design Thinking** Real-Time design interaction captures and analysis – Enabling efficient collaboration in digital space– Empathy for design – Collaboration in distributed Design	3
Module4	**Design Thinking in IT** Design Thinking to Business Process modelling – Agile in Virtual collaboration environment – Scenariobased Prototyping	2
Module5	**Design Thinking For strategic innovations** Growth – Story telling representation – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model	3
Module6	**Problem Solving & Critical thinking** Introduction to TRIZ, SCAMPER, UI and UX.	2
Module7	**Sustainable development goals (SDG)** Integrating and mapping 17 Sustainable development goals (SDG) during designing a product; goods or service. Introduction to 21^{st} Century Skill Set	1
Module8	**Case Study & Project Report Submission**	10

Text Books :

1. Karmin Design Thinking by Dr. Bala Ramadurai, Mudranik Technology Private Ltd. ISBN 978-93-5419-

0I0-0.
2. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.
3. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
4. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
5. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

Reference Books:

1. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.
2. Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author).
3. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins e-books, 2009.
4. Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Toolbox, John Wiley & Sons, 2020.
5. Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Playbook, John Wiley & Sons, 2018.
6. Kristin Fontichiaro, Design Thinking, Cherry Lake Publishing, USA, 2015.

Paper Name: BASICS ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY
Paper Code: EC191
Contact Hours (Period/week): 3L/Week
Credit: 1.5
Total Lecture: 36

Course Outcomes:

The Graduates of the ECE program will be able to:

CO1: Understand the fundamental concept of passive & active electrical & electronic components and electrical & electronics Instruments.

CO2: Apply KVL and KCL to solve electrical circuit's problems.

CO3: Examine the current voltage characteristics of PN junction diode, Zener diode and BJT.

CO4: Design electronics circuits using PN junction diode.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	1	-	-	-	-	2	2	-
CO2	3	3	1	1	-	-	-	-	2	2	-
CO3	3	2	2	2	1	-	-	-	3	2	-
CO4	3	3	3	3	1	-	-	1	3	2	3

List of Experiments: -

1. Familiarization with different passive electrical & electronic components.
2. Familiarization with different active electrical & electronic components.
3. Familiarization with different Electrical & Electronics Instruments.
4. Verification of KVL and KCL.

5. Determination of average value and RMS value of an AC signal.
6. Study of the V-I characteristics P-N junction diode (Forward & Reverse Bias)
7. Study of the V-I characteristics of Zener diode (Forward & Reverse Bias)
8. Study of half wave and full wave rectifier.
9. Study of clipper and clamper circuit.
10. Study of voltage regulator circuit.
11. Study of the Input and Output characteristics of BJT.
12. Extramural Experiment.

Textbooks:

1. Handbook of Laboratory Experiments in Electronics Engineering Vol. 1, Author Name: A.M. Zungeru, J.M. Chuma, H.U. Ezea, and M. Mangwala, Publisher -Notion Press Electronic Devices and Circuit Theory by Robert Boylestad Louis Nashelsky,7th Edition, Prentice Hall.
2. Experiments Manual for use with Grob's Basic Electronics 12th Edition by Wes Ponick, Publisher-McGraw Hill,2015.
3. Laboratory Manual for 'Fundamentals of Electrical & Electronics Engineering': A handbook for Electrical & Electronics Engineering Students by ManojPatil (Author), Jyoti Kharade (Author), 2020

Reference Books:

1. Basic Electrical and Electronics Engineering, Author:S. K. Bhattacharya, Publisher: Pearson Education India,2011
2. Practical Electrical Engineering.
3. Electronics Lab Manual (Volume 2) By Navas, K. A. Publisher: PHI Learning Pvt. Ltd. 2018.

Course Name	**Introduction to Artificial Intelligence Lab**
Course Code	**CS192**
Contact Hours (Period/week)	**3L/Week**
Total Contact Hours	**30**
Credit	**1.5**

Course Objectives:

The objectives of this course are to enable students to

1. Gain foundational knowledge of PROLOG to implement an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing
2. Formulate a problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
3. Apply the concepts of Artificial Intelligence to solve a problem by implementing well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
4. Build expert systems offering solutions to the challenging problems of Artificial Intelligence.
5. Implement Artificial Intelligence based ideas as executable PROLOG programs through developing intelligent heuristic strategies

Course Outcomes (COs):

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

CO1	**Acquire** foundational knowledge of PROLOG to **implement** an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing and **understand** the working principle of the agent and **assess** its utilitarian importance in current technological context leading towards lifelong learning.
CO2	**Identify** and **formulate** an engineering problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Agent Formulation Framework of Artificial Intelligence.
CO3	**Explore** relevant literature and **apply** the concepts of Artificial Intelligence to **solve** a problem by **implementing** well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
CO4	**Develop** ideas and **propose an** expert system offering solutions to the challenging problems of Artificial Intelligence.
CO5	**Plan and Implement** Artificial Intelligence based ideas as executable PROLOG programs through **developing** intelligent heuristic strategies or expert systems with adequate documentation in a collaborative environment for successfully carrying out projects on Artificial Intelligence Problems and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools.

CO–PO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	2	2	2	2	2	2	2	2	2	3

<u>Course Content:</u>

Module 1: Introduction to PROLOG Programming along with the IDE and its Basic Components

Assignments for understanding the Basic Components of Knowledge Representation and Inferencing in Artificial Intelligence using PROLOG Programming and its working strategy. Understanding facts, rules, queries, and syntax.

Module 2: Recursive definitions in Prolog

Fibonacci Series, Calculator, Factorial, summation, list length, etc. Using recursive rules.

Module 3: Defining facts and simple queries

Writing a knowledge base for family relationships, basic objects.

Module 4: **Rules and inference in Prolog**

Creating logical rules and testing inferences.

Module 5: List operations in Prolog

Checking membership, concatenation, reverse, max/min of list.

Module 6: Pattern matching and symbolic reasoning

Simple examples involving pattern recognition (e.g., shape or name matching, Family Tree desi

Module 7: Expert system simulation (Mini project)

Building a mini knowledge-based system (e.g., Animal Classification, Medical diagnosis, etc).

Textbook:

Ivan Bratko, Prolog Programming for Artificial Intelligence, 4th Edition, Addison-Wesley.

Course Name: ENGINEERING CHEMISTRY LAB
Paper Code: CH191
Total Contact Hours: 24
Credit: 1
Prerequisites: 10+2

Course Objective

- **Study the basic principles of pH meter and conductivity meter for different**
- **applications**
- **Analysis of water for its various parameters & its significance in industries**
- **Learn to synthesis Polymeric materials and drugs**
- **Study the various reactions in homogeneous and heterogeneous medium**

Course Outcome

CO1: Able to operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.
CO2: Able to analyze and determine the composition and physical property of liquid and solid samples when working as an individual and also as a team member
CO3: Able to analyze different parameters of water considering environmental issues
CO4: Able to synthesize drug and sustainable polymer materials.
CO5: Capable to design innovative experiments applying the fundamentals of modern chemistry

COURSE CONTENT

Any 10 experiments to be conducted preferably a combination of estimation, water quality analysis, instrumental analysis and synthesis

1. To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution.
2. Estimation of amount of Fe^{2+} in Mohr’s salt using per manganometry.
3. To determine the surface tension of a given liquid at room temperature using stalagmometerby drop number method.
4. To determine the viscosity of a given unknown liquid with respect to water at room temperature, by Ostwald’s Viscometer.
5. Water quality analysis :

    i. Determination of total, permanent and temporary hardness of sample water by complexometric titration.

    ii. Determination of Cl^- ion of the sample water by Argentometric method
    iii. Determination of alkalinity of the sample water.
    iv. Determination of dissolved oxygen present in a given water sample.

6. Determination of the concentration of the electrolyte through pH measurement.
7. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
8. Determination of cell constant and conductance of solutions.
9. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.
10. Determination of Partition Coefficient of acetic acid between two immiscible liquids.
11. Drug design and synthesis
12. Synthesis of polymers (Bakelite) for electrical devices and PCBs.
13. Synthesis of Silver Nanoparticles doped organic thin film for organic transistors.
14. Determination of R_F of any amino acid by thin layer chromatography.
15. Saponification /acid value of any oil.
16. Isolation of graphene from dead dry batteries

Course Title : IDEA Lab Workshop
Code : ME193
Contact Hour/Week : (L: 0, T: 0, P: 3)
Credit : 1.5

Course Objectives:

1. To learn all the skills associated with the tools and inventory associated with the IDEALab.
2. Learn useful mechanical and electronic fabrication processes.
3. Learn necessary skills to build useful and standalone system/ project withenclosures.
4. Learn necessary skills to create print and electronic documentation for thesystem/project

Course Contents*:*

Module1*:* Electronic component familiarization, Understanding electronic system design flow. Schematic design and PCB layoutand Gerber creation using Eagle CAD. Documentation using Doxygen, Google Docs, Overleaf.

Version control tools - GIT and GitHub.

Basic 2D and 3D designing using CAD tools such as FreeCAD,
Sketchup, Prusa Slicer, FlatCAM, Inkspace, Open BSP and VeriCUT.

Module2: Familiarisation and use of basic measurement instruments - DSO including various triggering modes, DSO probes, DMM, LCR bridge, Signal and function generator. Logic analyzer and MSO. Bench power supply (with 4-wire output)

Circuit prototyping using (a) breadboard, (b) Zero PCB (c) 'Manhattan' style and (d) custom PCB. Single, double and multilayer PCBs. Single and double-sided PCB prototype fabrication in the lab. Soldering using soldering iron/station. Soldering using a temperature controlled reflow oven. Automated circuit assembly and soldering using pick and place machines.

Module3: Electronic circuit building blocks including common sensors. Arduino and Raspberry Pi programming and use. Digital Input and output.
Measuring time and events. PWM. Serial communication. Analog input.Interrupts programming. Power Supply

design (Linear and Switchingtypes), Wireless power supply, USB PD, Solar panels, Battery types and charging

Module4: Discussion and implementation of a mini project.

Module5: Documentation of the mini project (Report and video).

Laboratory Activities:

Sl.No.	List of Lab activities and experiments
1.	Schematic and PCB layout design of a suitable circuit, fabrication and testiof the circuit.
2.	Machining of 3D geometry on soft material such as soft wood or modelling w
3.	3D scanning of computer mouse geometry surface. 3D printing of scanngeometry using FDM or SLA printer.
4.	2D profile cutting of press fit box/casing in acrylic (3 or 6 m thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.
5.	2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.
6.	Familiarity and use of welding equipment.
7.	Familiarity and use of normal and wood lathe.
8.	Embedded programming using Arduino and/or Raspberry Pi.
9.	Design and implementation of a capstone project involving embedded hardwasoftware and machined or 3D printed enclosure.

Reference Books:

Sl no	Title
1.	AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with LabManual), Khanna Book Publishing, New Delhi.
2.	All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13:978-9386173393, Khanna Book Publishing Company, New Delhi.
3.	Simplified Q&A - Data Science with Artificial Intelligence, Machine Learningand Deep Learning, Rajiv Chopra, ISBN: 978-9355380821, Khanna Book Publishing Company, New Delhi.
4.	3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, KhannaBook Publishing Company, New Delhi.
5.	The Big Book of Maker Skills: Tools & Techniques for Building Great TechProjects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.
6.	The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan (Author). Weldon Owen; 2017. ISBN-13: 978-1681881584.
7.	Make: Tools: How They Work and How to Use Them. Platt, Charles.Shroff/Maker Media. 2018. ISBN-13: 978-9352137374
8.	The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill.Cambridge University Press. ISBN: 9780521809269
9.	Practical Electronics for Inventors. 4th edition. Paul Sherz and SimonMonk. McGraw Hill. ISBN-13: 978-1259587542

10.	Encyclopedia of Electronic Components (Volume 1, 2 and 3). CharlesPlatt. ShroffPublishers. ISBN-13: 978-9352131945,978- 9352131952,978-9352133703
11.	Building Scientific Apparatus. 4th edition. John H. Moore, Christopher C.Davis, Michael A. Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586
12.	Programming Arduino: Getting Started with Sketches. 2nd edition.Simon Monk. McGraw Hill. ISBN-13: 978-1259641633
13.	Make Your Own PCBs with EAGLE: From Schematic Designs to FinishedBoards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13 : 978-1260019193.
14.	Pro GIT. 2nd edition. Scott Chacon and Ben Straub. A press. ISBN-13 :978- 1484200773
15.	Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based andOther Technologies, Kluwer, 2004.
16.	Ian Gibson, David W Rosen, Brent Stucker., "Additive ManufacturingTechnologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
17.	Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBSPublishers and distributors, 5th Edition,2002.

Course Name: SOLID STATE DEVICES
Course Code: EC201
Contact Hour: 3(L):0(T):0(L)
Total Contact Hours: 36
Credits: 3

Prerequisites: Electronic structure of atoms, crystalline and non-crystalline solids, unit cells, Miller index, conductors, semiconductors and insulators, electrical properties, basic concept of electronic devices.

Course Objectives:

1. To understand the fundamentals of semiconductor behaviour and the operation of basic semiconductor devices.
2. Understanding of a 'top-down' view of traditional electronic device.
3. Understanding of a vast array of other more advanced semiconductor devices.
4. Understand and describe the impact of solid-state device capabilities and limitations on electronic circuit performance.
5. Develop the basic tools with which newly developed devices and other semiconductor applications can be studied.

Course Outcomes: The students will be able to:

CO1: Apply the energy band diagram based on nearly free electron model to quantify charge carrier transport phenomenon, recombination generation process of different types of semiconductor materials.

CO2: Develop models of semiconductor devices like Diode, BJT, MOSFET, JFET to provide terminal current vs voltage and capacitance vs voltage characteristics.

CO3: Analyse the performances of devices based on the physical design parameters and secondary phenomena for application in circuits.

CO4: Correlate the performances of photo devices for sustainable development goal (SDG)

CO5: Integrate Energy band Diagram with Hetero junction devices.

CO-PO mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	1	1	2	3	1	2
CO2	3	3	3	3	2	1	1	2	3	2	2
CO3	3	3	3	3	2	1	1	2	3	1	2
CO4	3	3	3	3	2	3	1	2	3	2	2
CO5	3	3	3	3	3	1	1	2	3	1	2

Course Contents:

Module I: Charge Carriers in Semiconductors: [8L]

Introduction to semiconductor physics: review of quantum mechanics, electrons in periodic lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; intrinsic & extrinsic semiconductor. Effect of temperature and energy gap on intrinsic concentration, effect of temperature on extrinsic semiconductor, derivation of equilibrium electron and hole concentration in terms of effective density of states and intrinsic level, derivation of electron and hole concentration in a compensated semiconductor, basic concept on optical absorption, photo luminescence, carrier lifetime, carrier generation and recombination, continuity equation (expression and significance only). Degeneracy and non- degeneracy of semiconductors. Non-equilibrium condition: Effect of temperature and doping concentration on mobility, Effective mobility due to scattering effect, drift & diffusion of carriers, high field effect on drift velocity, Hall effect and piezo electric effect, generation and recombination, quasi Fermi energy level (concept only).

Procedure for analyzing semiconductor devices, Basic equations and approximations

Module II: P-N Junction Diode: [6L]

Energy Band Diagram, Calculation of Barrier height, Space charge width. Junction and Depletion Capacitances, Diode Equivalent Circuits, Small signal model, Large signal model. V-I characteristics of diode, Reverse Recovery Transients, voltage multipliers, diode as gate. Basic CCD (charge coupled devices) Structure, charge transfer and frequency response, Buried channel CCD. Ideal MIS diode. Surface Space-charge region,

Module III: Bipolar Junction Transistor: [4L]

Punch-through and avalanche effect, expression for punch through voltage and avalanche break down voltage (no derivation), Solution of continuity equation and Poisson's equation for BJT, Ebers - Moll, Static, large-signal, small-signal models, Temperature and area effects. Equivalent circuits, h-parameter model, origin of parameters in hybrid-pi model, time delay factors in BJT, alpha and beta cut-off frequency, Numerical Problems.

Module IV: Field Effect Transistors: [8L]

Metal Oxide Field Effect Transistor (MOSFET): Types of MOSFET, structure of EMOSFET, MOS structure under external bias-accumulation, depletion and inversion phenomenon with energy band diagram, threshold voltage and flat band voltage; working of E-MOSFET with characteristics, drain current equation for linear and saturation region with condition (expression only), channel length modulation, derivation of threshold voltage of ideal and non-ideal MOSFET Capacitance-Different types of MOSFET Capacitances, MOS capacitance variation with gate to source voltage under low frequency & high frequency, large and small signal model of MOSFET(explanation with diagram).

Junction Field Effect Transistor (JFET): Construction, field control action and I-V characteristics, parameters of JFET, small signal analysis of JFET.

Module V: Advanced Semiconductor Devices: [5L]

Opto-electronic Devices: LED: Radiative transitions, emission spectra, luminescent efficiency, light emitting materials, working of LED, visible and infrared LEDs, Photo detectors: general features, gain, band width and signal to noise ratio, principle of operation: photodiode, p-i-n, meta-semiconductor photo diode, Solar cells: current and voltage in illuminated junction, p-n junction solar cells, I-V characteristics, solar radiation, conversion efficiency and spectral response, applications

Semiconductor Laser: Basics of laser physics, population invasion, stimulated emission and lasing action in p-n junction, spectral response of p-n junction Laser**.**

MESFET, FinFET, TFET (construction and characteristics).

Module VI: Metal-semiconductor contacts: [5L]

Metal-semiconductor contacts: Hetero Junction Energy band diagram ; surface states, Depletion layer, Schottky effect. Current transport processes. Thermionic emission theory. Diffusion theory, Tunneling current, Minority-carrier ~ injection ratio, characterization of barrier height. Classification of Heterojunction;2D Electron Gas (Isotype Heterojunction), n-isotype Heterojunction, I-V Characteristics Device structures, Ohmic contact and Schottky Contact.

Textbooks:
1. Ben G Streetman, S K Banarjee, Solid State Electronic Devices, 6th edition, PHI India, New Delhi, 2007
2. S. M. Sze, K. K. Ng, Physics of Semiconductor Devices, 3rd edition, John Wiley, New Jersey, 2007.
3. R S Muller, T.I. Kamins, Device Electronics for Integrated Circuits, 3rd edition, Wiley India, New Delhi, 2012. 4. D. Neamen, -Semiconductor Physics and Devices TMH.

Reference Books:
1. Milman, Halkias–Integrated Electronics–TMH.
2. Sedra & Smith-Microelectronic Circuits-Oxford.
3. S.M.Kang andY. Leblebici.-CMOS Digital Integrated Circuits, Tata Mc Graw-Hill.

Course Name: CIRCUIT THEORY & NETWORK
Course Code: EC 202
Contact Hour/Week: 3(L):0(T):0(L)
Total Contact Hours: 36
Credits: 3

Prerequisites: Properties of series and parallel connections, concept of KCL, KVL, complex number, current-voltage phasor diagram, DC and AC, Charging and discharging of capacitor, Energizing and decaying of inductor.

Course Objective: Objective of this course is to understand basic concepts of DC and AC circuit behaviour. Develop and solve mathematical representations for simple RLC circuits. Understand the use of circuit analysis theorems and methods.

Course Outcomes: Graduates of the ECE program will be to:

CO1: Analyze series and parallel resonance circuit based on parameters: resonance frequency, band-width, upper & lower cut-off frequency, quality factor and impedance for the designing of single tuned circuit
CO2: Determine current, voltage and power at different branch for DC and AC circuit using networks theorems.
CO3: Solve branch current and branch voltage with the help of planner graph of a circuit using cut-set and tie set matrix.
CO4: Apply Laplace Transform technique for the determination of current, voltage and power in magnetically coupled and transient circuits.
CO5: Estimate parameters of two port network through open circuit & short circuit test for the development of the model of the circuit.

CO-PO mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	-	-	-	2	-	-	2
CO2	3	3	3	3	-	-	-	-	--	--	3
CO3	3	3	3	2	-	-	-	-		-	3
CO4	3	3	3	3	-	-	-	-	-	-	3
CO5	3	3	3	3	-	-	-	2	-	-	2

Course Content:

Module I: Methods of Analysis and Network Theorems. [10L]

Node and Mesh analysis in DC and AC circuits with independent and dependent sources, super node &super mesh; Star-Delta transformation technique in DC &AC circuits; Solving problems using network theorems- Superposition theorem, Thevenin's theorem, Nortons theorem, Maximum Power Transfer theorem, Reciprocity theorem in DC & AC Circuits with independent and dependent sources; Sinusoidal steady state analysis, complex power.

Module II: Circuit Analysis in S-Domain and Time Domain [9L]

Laplace transform: Step function, GATE function, Impulse function, Delta function, Periodic functions - Rectangular & Triangular wave, strain of pulses; initial & final value theorem; Circuit analysis & solution of numerical problems in S-domain.

Transient analysis in RC, RL, RLC circuit with DC excitations – determination of circuit parameters at time (t=0, t=0+, t=0-, t > 0) with numerical examples; RC, RL, RLC circuit with sinusoidal excitation (concept only).

Module III: Resonance in RLC Circuit [4L]
RLC series and parallel resonance circuit - condition of resonance, resonance frequency, impedance & admittance characteristics, quality factor, half power points, bandwidth, phasor diagrams, properties of series and parallel resonance; Solution of problems.

Module IV: Two Port Network [5L]
Two port network analysis – Z, Y, h and ABCD parameters; conditions of reciprocity and symmetry in terms of two port parameters; equivalent circuit in terms of Z, Y and h parameters; Interrelation between different two port parameters (concept only); Solutions of circuit problems using two port parameters.

Module V: Magnetically Coupled Circuit [4L]
Self & Mutual inductance; Polarity of induced voltage in magnetically coupled circuit; Determination of equivalent inductance in series and parallel magnetically coupled network; Numerical examples for the determination current, voltage and power of a magnetically coupled network.

Module VI: Graph of a Network [4L]
Development of graph of a network -planner and non-planner graph, branch, tree, twigs; Incidence Matrix, Cut Set Matrix, Tie Set Matrix for a graph of circuit; Application of graph to solve problems in circuit.

Text/ Reference Books:
1. A.Chakrabarti - Circuit Theory: Analysis and Synthesis , Dhanpat Rai & Co. 7th edition 2018
2. Valkenburg M. E. Van, "Network Analysis", Prentice Hall. /Pearson Education , 3rd edition 2019
3. D. Roy Chowdhury -Networks and Systems, New Age International, 4th edition 2017
4. Reference Books:
5. B.L. Thereja and A.K. Thereja - A Textbook of Electrical Technology: Basic Electrical Engineering in S. Units (Volume - 1), S-Chand , 2nd edition 2005

6. Sudhakar: Circuits & Networks: Analysis & Synthesis" 2/e TMH, 5th edition 2017
D.A.Bell- Electrical Circuits- Oxford, 7th edition 2009

Course Name: ENGINEERING PHYSICS
Course Code: PH201
Contact Hour/Week: 3(L):0(T):0(L)
Total Contact Hours: 36
Credits: 3
Prerequisites: Knowledge of Physics up to class 12th standard.

Course Objectives:
The aim of courses in Physics-I is to provide adequate exposure and develop insight about the basic principles of physical sciences and its practical aspects which would help engineers to learn underlying principles of various tools and techniques they use in core engineering and related industrial applications. The course would also inculcate innovative mindsets of the students and can create awareness of the vital role played by science and engineering in the development of new technologies.

COURSE OUTCOME: On successful completion of the course Students will be able to
CO1: *Explain* the principles of lasers, fibre optics, and holography and *apply* them in modern optical and communication systems.
CO2: *Identify* different crystal structures and *compute* structural parameters such as Miller indices and packing factors; *distinguish* between metals, semiconductors, and insulators using band theory.
CO3: *Utilize* the principles of quantum theory—including quantization, wave-particle duality, and Schrödinger equation—to *interpret* fundamental quantum phenomena.
CO4: *Illustrate* the basic concepts of statistical mechanics and e*xamine* their implications on microscopic particle behaviour.
CO5: *Describe* the properties of nanomaterials and display/storage devices and *analyze* their applications in modern technology.

CO-PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3								2		2
CO2	3	3							2		2
CO3	3	3							2		2
CO4	3	3							2		2
CO5	3	3							2		2

Course Content:

Module 1 (11L)
Modern Optics
1.01- Laser: Concepts of various emission and absorption processes, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser, related numerical problems. 6L
1.02-Fibre Optics-Principle and propagation of light in optical fibers (Step index, Graded index, single and multiple modes) - Numerical aperture and Acceptance angle, Basic concept of losses in optical fiber, related numerical problems. 3L
1.03-Holography-Theory of holography (qualitative analysis), viewing of holography, applications

2L

Module 2 (5L)
Solid State Physics
2.01 Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numerical problems. 3L

2.02 Semiconductor: Physics of semiconductors, electrons and holes, metal, insulator and semiconductor, intrinsic and extrinsic semiconductor, p-n junction. 2L

Module 3 (14L)
Quantum and Statistical Mechanics
3.01 Quantum Theory: Inadequacy of classical physics-concept of quantization of energy, particle concept of electromagnetic wave (example: Black body radiation, Photoelectric and Compton Effect: no derivation required), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment, related numerical problems. 5L

3.02 Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions-Qualitative discussion; uncertainty principle, relevant numerical problems, Introduction of Schrödinger wave equation (only statement). 4L

3.03 Statistical Mechanics
Concept of energy levels and energy states, phase space, microstates, macrostates and thermodynamic probability, MB, BE, FD, statistics (Qualitative discussions)-physical significance, conception of bosons, fermions, classical limits of quantum statistics, Fermi distribution at zero & non-zero temperature, Concept of Fermi level-Qualitative discussion. 5L

Module 4 (4L)
Physics of Nanomaterials
Reduction of dimensionality, properties of nanomaterials, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Quantum size effect and Quantum confinement. Carbon allotropes. Application of nanomaterials (CNT, graphene, electronic, environment, medical).

Module 5 (2L)
Storage and display devices
Different storage and display devices-Magnetic storage materials, Operation and application of CRT, CRO, LED and OLED.

Text books
1. Concepts of Modern Engineering Physics- A. S. Vasudeva. (S. Chand Publishers)
2. Engineering Physics - Rakesh Dogra
3. Introduction to Nanoscience and Nanotechnology, An Indian Adaptation-Charles P. Poole, Jr., Frank J. Owens.

Reference books.
1. Optics - Ajay Ghatak (TMH)
2. Solid state Physics - S. O. Pillai
3. Quantum mechanics -A.K. Ghatak and S Lokenathan
4. Fundamental of Statistical Mechanics: B. B. Laud
6. Perspective & Concept of Modern Physics—Arthur Beiser

Course Name: Engineering Mathematics - II
Paper Code: M201
Contact Hour/Week: 3(L):0(T):0(L)
Total Contact Hours: 36
Credit: 3

Prerequisites:

The students to whom this course will be offered must have the understanding of (10+2) standard algebraic operations, and elementary calculus concepts including limits, continuity, differentiation, and integration.

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations, Laplace transform and numerical methods. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1. Apply analytical methods to solve ordinary differential equations in engineering contexts.

CO2. Apply the properties and inverse of Laplace Transforms to compute improper integrals and determine solutions of linear ordinary differential equations with constant coefficients in engineering scenarios.

CO3. Apply numerical methods to interpolate data, perform numerical integration, and solve ordinary differential equations in engineering applications.

CO4. Analyze the behavior of solutions using analytical and numerical approaches, including Laplace transforms, to assess stability, convergence, and accuracy in engineering contexts.

CO-PO/PSO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	1
CO4	3	3	1	1	-	-	-	-	-	-	2
M 201	**3**	**2.25**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1.25**

’ **Course Content:**

Module I: (9L)

First Order Ordinary Differential Equations (ODE)

Solution of first order and first degree ODE**:** Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli’s equation.

Solution of first order and higher degree ODE: solvable for$p$, solvable for y and solvable for $x$and Clairaut’s equation.

Module II: (8L)

Second Order Ordinary Differential Equations (ODE)

Solution of second order ODE with constant coefficients: Complementary Function and Particular Integral, Method of variation of parameters, Cauchy-Euler equations.

Module III: (12L)

Laplace Transform (LT)

Concept of improper integrals; Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of $tf(t)$, LT of $\frac{f(t)}{t}$, LT of ~~deri~~vatives of

$f(t)$, LT of integral of $f(t)$, Evaluation of improperintegrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties,Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution oflinear ODE with constant coefficients (initial value problem) using LT.

Module IV: (7L)

Numerical Methods

Introduction to error analysis, Calculus of finite difference. Interpolation: Newton forward and backward interpolation, Lagrange's interpolation. Numerical integration: Trapezoidal rule, Simpson's 1/3 Rule. Numerical solution of ordinary differential equation: Euler method, Fourth order Runge-Kutta method.

Text Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Reference Books:

1. Guruprasad, S. A text book of Engineering Mathematics-I, New age International Publishers.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
5. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
6. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
7. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
8. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
9. Bronson, R., Schaum's Outline of Matrix Operations. 1988.
10. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.

Subject Name: ENVIRONMENTAL SCIENCE
Paper Code: HU201
Contact Hour/Week: 3(L):0(T):0(L)
Credits: 2
Total Contact Hours: 24

Prerequisites: Knowledge of 10+2 standard Physics and Chemistry

Course Objective (s)

This course will enable the students to,

- Realize the importance of environment and its resources.
- Apply the fundamental knowledge of science and engineering to assess environmental and health risk.
- Know about environmental laws and regulations to develop guidelines and procedures for health and safety issues.
- Solve scientific problem-solving related to air, water, land and noise pollution.

Course Outcome

CO	Statement
C01	Able to understand the natural environment and its relationships with human activities
C02	The ability to apply the fundamental knowledge of science and engineering to assess environmental and health risk
C03	Ability to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues

CO4	Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

Course Content:

Module 1 - Resources and Ecosystem (6L)

1. **Resources (4L)**

Types of resources, Human resource, Population Growth models: Exponential Growth, Logistic growth curve with explanation. Maximum Sustainable Yield [Derivation]

Alternative sources of Energy [Solar energy, tidal energy, geothermal energy, biomass energy]

2. Ecosystem (2L)

Components of ecosystem, types of ecosystem, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Pond eco system, Food chain, Food web.

Module 2 – Environmental Degradation (10L)

1. **Air Pollution and its impact on Environment (3L)**

Air Pollutants, primary & secondary pollutants, Criteria pollutants, Smog, Photochemical smog and London smog, Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion.

2. Water Pollution and its impact on Environment (4L)

Water Pollutants, Oxygen demanding wastes, heavy metals, BOD [Rate equation], COD, Eutrophication, Hardness, Alkalinity, TDS and Chloride, Heavy metal (As, Hg, Pb) poisoning and toxicity. Numerical on BOD, Hardness.

3. Land Pollution and its impact on Environment (1L)

Solid wastes, types of Solid Waste, Municipal Solid wastes, hazardous wastes, bio-medical wastes, E-wastes,

4. Noise Pollution and its impact on Environment (2L)

Types of noise, Noise frequency, Noise pressure, Measurement of noise level and decibel (dB) Noise intensity, Noise Threshold limit, Effect of noise pollution on human health. Numerical on Measurement of noise level and decibel (dB) and Noise Threshold limit.

Module 3 – Environmental Management (6L)

1. **Environmental Impact Assessment (1L)**

Environmental Auditing, Environmental laws and Protection Acts of India, carbon footprint, Green building practices. *(GRIHA norms)*

2. Pollution Control and Treatment (2L)

Air Pollution controlling devices, Catalytic Converter, Electrostatic Precipitator.

WasteWater Treatment (Surface water treatment &Activated sludge process), Removal of hardness of water (Temporary &Permanent -Permutitprocess).

3. Waste Management (3L)

Solid waste management, Open dumping, Land filling, incineration, composting & Vermicomposting, E-waste management, and Biomedical Waste management.

Module 4 – Disaster Management (2L)

1. **Study of some important disasters (1L)**

Natural and Man-made disasters, earthquakes, floods drought, landslide, cyclones, volcanic eruptions, tsunami, oil spills, forest fires.

2.Disaster Management Techniques (1L)

Basic principles of disaster management, Disaster Management cycle, Disaster management policy, Awareness generation program

Text Books:

1. Basic Environmental Engineering and Elementary Biology (For MAKAUT), Gourkrishna Dasmohapatra, Vikas Publishing.
2. Basic Environmental Engineering and Elementary Biology, Dr. Monindra Nath Patra & Rahul Kumar Singha, Aryan Publishing House.
3. Textbook of Environmental Studies for Undergraduate Courses, Erach Barucha for UGC, Universities Press

Reference Books:

1. A Text Book of Environmental Studies, Dr. D.K. Asthana & Dr. Meera Asthana, S.Chand Publications.
2. Environmental Science (As per NEP 2020), Subrat Roy, Khanna Publisher

Paper Name: INDIAN KNOWLEDGE SYSTEM
Paper Code: HU202
Contact Hour/Week: 3(L):0(T):0(L)
Credit: 01
No. of lectures: 12

Course outcome: On completing this course the student will be able

CO1: To define, identify, describe and classify the philosophical, literary and socio-religious heritage of ancient India and the core concepts of the Vedic corpus and way of life.

CO2: To discover, enumerate, compare, contrast and categorize the importance of pioneering developments in science and mathematics and evaluate their continuing relevance.

CO3: To analyze, appraise, correlate and describe the ancient Indian heritage in science and technology and examine technological correlations with present-day technological applications.

C04: To discover, assess and describe traditional knowledge in health care, architecture, agriculture and other sectors and to explore the history of traditional Indian art forms.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	1	2	-	3	-	3
CO2	2	-	1	-	-	2	-	-	3	-	3
CO3	3	1	1	1	2	3	-	-	3	-	3
CO4	2	-	1	-	2	3	-	-	3	-	3

<u>**Course Content:**</u>

Module-1 **3L**

An overview of Indian Knowledge System (IKS): Importance of Ancient Knowledge - Definition of IKS - Classification framework of IKS - Unique aspects of IKS.
The Vedic corpus: Vedas and Vedangas - Distinctive features of Vedic life.
Indian philosophical systems: Different schools of philosophy (Orthodox and Unorthodox).

Module-2 **3L**

Salient features of the Indian numeral system: Developments in Indian Mathematics in ancient India - Importance of decimal representation - The discovery of zero and its importance - Unique approaches to represent numbers- Contribution of ancient Indian mathematicians
Highlights of Indian Astronomy: Historical development of astronomy in India- key contributions of ancient Indian astronomers.

Module-3 **3L**

Indian science and technology heritage: Metals and metalworking - Mining and ore extraction –Structural engineering and architecture in ancient India: planning, materials, construction and approaches- Dyes and painting; Shipbuilding.

Module-4 3L

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering. Traditional Agricultural practices (resources, methods, technical aids); Traditional Medicine and Surgery; History of traditional Art forms and Culture.

Text Books:

1. Amit Jha . *Traditional Knowledge System in India*. New Delhi: Atlantic Publishers, 2024.
2. B. Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana . *Introduction to Indian Knowledge System: Concepts and Applications*. New Delhi: PHI, 2022.
3. Angad Godbole. *Science and Technology in Ancient India*. New Delhi: Biblia Implex, 2023.
4. Pritilakshmi Swain. *Indian Knowledge System*. New Delhi: Redshine Publication, 2024.
5. Vishnudut Purohit. *Fundamentals of Indian Knowledge System*. New Delhi: ABD Publishers, 2024.

Reference Books:

1. A. L. Basham. *The Wonder that was India*. Vol. I. New Delhi: Picador, 2019.
2. Arun Kumar Jha and Seema Sahay ed. *Aspects of Science and Technology in Ancient India.* Oxford and New Delhi: Taylor and Francis, 2023.
3. Kapil Kapoor and Awadhesh Kumar Singh. *Indian Knowledge Systems*. Vols. 1 and 2. New Delhi: D. K. Printworld, 2005.
4. S. N. Sen and K. S. Shukla, *History of Astronomy in India*. New Delhi: Indian National Science Academy, 2nd edition, 2000.
5. Arpit Srivastava. *Indian Knowledge System*. Rewa: AKS University, 2024.

Subject Name: SOLID STATE DEVICE LAB,
Code: EC291
Contact Hour/Week: 0(L):0(T):3(L)
Credit: 1.5
Prerequisites: Concept of Basic Electronics Lab performed in 1st semester.

Course Outcome

After the completion of the syllabus Students will be able to

CO1: Verify the working of different diodes, transistors, CRO probes and measuring instruments. Identifying the procedure of doing the experiment.

CO2: Understand the characteristics of BJT and FET and how to determine different parameters for designing purpose.

CO3: Understand the properties of photoelectric devices and will be able to analyze experimental data and results.

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	1	1	2	3	1	2
CO2	3	3	3	3	2	1	1	2	3	2	2
CO3	3	3	3	3	2	1	1	2	3	1	2

Course Content:

1. Study of the characteristics graph of P-N junction diode

a) Plot the Volt Ampere Characteristics of PN Junction Diode under Forward and Reverse Bias

Conditions.
b) Find the Cut-in voltage, Static Resistance, Dynamic Resistance for Forward Bias & Reverse Bias

2. Study the Characteristics of Zener Diode & Load Regulation
a) Obtain the Forward Bias and Reverse Bias characteristics of a Zener diode.
b) Find out the Zener Break down Voltage from the Characteristics.
c) Obtain the Load Regulation Characteristics.

3. Study Common Emitter Bipolar Junction Transistor input Characteristics
a) Plot the Input characteristics of a transistor connected in Common Emitter Configuration
b) Find the h – parameters h_{ie} and h_{re} from the characteristics

4. Study Common Emitter Bipolar Junction Transistor output Characteristics
a) Plot the Output characteristics of a transistor connected in Common Emitter Configuration
b) Find the h – parameters h_{fe} and h_{oe} from the characteristics

5. Study of JFET Drain & Transfer Characteristics in Common Source mode.
a) Plot Drain characteristics
b) Plot Transfer Characteristics.
c) Find rd(Drain resistance), gm (Trans conductance), and μ (Amplification factor) from the characteristics.

6. Study of MOSFET Drain & Transfer Characteristics in Common Source mode.
a) Plot Drain characteristics
b) Plot Transfer Characteristics.
c) Find rd(Drain resistance), gm (Trans conductance), and μ (Amplification factor) from the characteristics

7. Study the I-V Characteristics of Photo transistor with and without illumination condition.

8. Study the I-V Characteristics of LED & LDR with and without illumination condition.

Course Name: Circuit Theory and Networks Lab
Course code: EC 292
Contact Hour/Week: 0(L):0(T):3(L)
Credit: 1.5

Prerequisites: Concept of series and parallel connections, concept of KCL, KVL, circuit with electrical components, DC, and AC source

Course Objective: The objective of this course is to understand current and electric circuits is critical to understanding how electricity works.

Course Outcomes: The Graduates of the ECE program will be able to:

CO1: Determine current, voltage and power in a DC and AC circuit with the help of network Theorems, Superposition theorem, Thevenin's & Norton's theorem, Maximum power transfer theorem, Compensation theorem and Millman's theorem.
CO2: Measure Z, Y, h & ABCD parameters of a two-port network following open circuit and short circuit test and conclude whether the network is symmetrical or reciprocal or both.
CO3: Construct RLC series & parallel resonance circuit and analyze its performance though the determination of resonance frequency, bandwidth, upper& lower cut-off frequency, quality factor and impedance at audio frequency range.
CO4: Estimate transient & steady state value of current & voltage in RC, RL & RLC circuit with DC excitations range up to 25 V from the transient response curve.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	3	-	2	3	3	2	3
CO2	3	3	3	2	3	-	2	3	3	2	3
CO4	3	3	3	2	3	-	2	3	3	2	3
CO4	3	3	3	2	3	-	2	3	3	2	3

List of Experiments:

1. Verification of Superposition theorem.
2. Thevenin's Theorem, Norton' s Theorem.
3. Study of maximum power transfer theorem
4. Study of reciprocity theorem.
5. Determination of Z & Y parameters of a two-port network.
6. Determination of h & ABCD parameters of two port networks.
7. Study of series and parallel RLC resonance circuit.
8. Transient response in RC and RL circuit.
9. Transient response in RLC circuit.
10. Innovative experiment.

Course Name: Engineering Physics Lab
Course Code: PH291
Contact Hour/Week: 0(L):0(T):3(L)
Total Contact Hours: 36
Credits: 1.5

Prerequisites: Knowledge of Physics up to 12^{th} standard.
Course Objectives:
The aim of course is to provide adequate exposure and develop insight about the basic principles of physical sciences and its practical aspects which would help engineers to learn underlying principles of various tools and techniques they use in core engineering and related industrial applications. The course would also inculcate innovative mindsets of the students and can create awareness of the vital role played by science and engineering in the development of new technologies

Course Outcomes
After completion of this course the students will be able to
CO1: *Determine* mechanical properties such as Young's modulus and rigidity modulus through hands-on experiments and *analyze* material behaviour under applied forces.
CO2: *Perform* optical experiments including Newton's Rings, laser diffraction, and optical fiber characterization, and *interpret* the results based on wave optics principles.
CO3: *Investigate* quantum effects such as the photoelectric effect and atomic transitions, and *relate* experimental outcomes to basic quantum principles.
CO4:*Study* the performance of semiconductor and electronic devices like solar cells, LEDs, and LCR circuits, and *investigate* their operational characteristics.
CO5:*Conduct* experiments such as Hall Effect, e/m determination, prism dispersion, or optical rotation to *demonstrate* the application of advanced physical principles in practical scenarios.

CO-PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3						3	2		2
CO2	3	3			3			3	2		2

CO3	3				3			3	2		2
CO4	3	3			3			3	2		2
CO5	3	3			3			3	2		2

Course Content:

General idea about Measurements and Errors (One Mandatory):

i) Error estimation using Slide callipers/ Screw-gauge/travelling microscope for one experiment.

Experiments on Classical Physics (Any 4 to be performed from the following experiments):

1. Study of Torsional oscillation of Torsional pendulum & determination of time using various load of the oscillator.
2. Determination of Young's moduli of different materials.
3. Determination of Rigidity moduli of different materials.
4. Determination of wavelength of light by Newton's ring method.
5. Determination of wavelength of light by Laser diffraction method.
6. Optical Fibre-numerical aperture, power loss.

Experiments on Quantum Physics (Any 2 to be performed from the following experiments):

7. Determination of Planck's constant using photoelectric cell.
8. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
9. Determination of Stefan's Constant.

10a. Study of characteristics of solar cell (illumination, areal, spectral)

10b. Study of characteristics of solar cell (I-V characteristics, Power-load characteristics, Power-wavelength characteristics)

Perform at least one of the following experiments:

11. Determination of Q factor using LCR Circuit.
12. Study of I-V characteristics of a LED/LDR.
13. Determination of band gap of a semiconductor.

**In addition, it is recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as

Innovative experiment.

Probable experiments beyond the syllabus:

1. Determination of the specific charge of the electron (e/m) from the path of an electron beam by Thomson method.
2. Determination of Hall co-efficient of a semiconductor and measurement of Magnetoresistance of a given semiconductor3. Study of dispersive power of material of a prism.

3. Determination of thermal conductivity of a bad/good conductor using Lees-Charlton / Searle apparatus.
4. Determination of the angle of optical rotation of a polar solution using polarimeter.
5. Any other experiment related to the theory.

Recommended Text Books for Engineering Physics Lab:

Waves & Oscillations:

1. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit Classical & Modern Optics:
2. A text book of Light- K.G. Mazumder & B.Ghosh (Book & Allied Publisher)

Quantum Mechanics-I

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House) Solid

State Physics:

1. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)

Text Books:

1. Practical Physics by Chatterjee & Rakshit (Book & Allied Publisher)
2. Practical Physics by K.G. Mazumder (New Central Publishing) 3. Practical Physics by R. K. Kar (Book & Allied Publisher)

COURSE NAME: ENGINEERING GRAPHICS & COMPUTER AIDED DESIGN LAB
COURSE CODE: ME294
Contact Hour/Week: 0(L):0(T):3(L)
CREDITS: 1.5

Prerequisites: Basic knowledge of geometry

Course Outcomes: Upon successful completion of this course, the student will be able to:

CO1: Use common drafting tools with the knowledge of drafting standards
CO3: Understand the concepts of engineering scales, projections, sections.
CO4: Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints
CO5: Produce part models; carry out assembly operation and represent a design project work.

CO-PO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2			2							
CO2	2			2							
CO3	3			2							
CO4	3			3							
CO5	3	2		3	2						

<u>**Course Contents:**</u>

Basic Engineering Graphics: **3P**

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Module 1: Introduction to Engineering Drawing **6P**

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections **6P**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes on inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes-Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice- versa.

Module 3: Sections and Sectional Views of Right Angular Solids **6P**

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only).

Computer Graphics: **3P**

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling.

Module 4: Overview of Computer Graphics 3P

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering 6P

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerance; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers, changing line lengths (extend/lengthen); Drawing sectional views of solids; Drawing annotation, CAD modelling of parts and assemblies with animation, Parametric and nonparametric solid, surface and wireframe modelling, Part editing and printing documents.

Module 6: Demonstration of a simple team design project 3P

Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House
2. K. Venugopal, Engineering Drawing + AutoCAD, New Age International publishers

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

Paper Name: **Communication and Presentation Skill**
Paper Code: **HU291**
Contact Hour/Week: 0(L):0(T):3(L)
Total Contact Hours: 36
Credit: 1.5

Pre requisites: Basic knowledge of LSRW skills.

Course Objectives: To train the students in acquiring interpersonal communication skills by focusing on language skill acquisition techniques and error feedback.

Course Outcome:
By pursuing this course the students will be able to:
CO1: Recognize, identify and express advanced skills of Technical Communication in English and Soft Skills through Language Laboratory.
CO2: Understand, categorize, differentiate and infer listening, speaking, reading and writing skills in societal and professional life.
CO3: Analyze, compare and adapt the skills necessary to be a competent interpersonal communicator in academic and global business environments.
CO4: Deconstruct, appraise and critique professional writing documents, models and templates.
CO5: Adapt, negotiate, facilitate and collaborate with communicative competence in presentations and work-specific conclaves and interactions in the professional context.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	-	1	2	3	-
CO2	-	2	-	-	-	2	-	-	-	3	-
CO3	-	-	-	-	-	2	-	-	3	3	-
CO4	-	2	-	-	-	-	-	3	-	3	-
CO5	-	-	-	-	-	3	-	-	3	3	-

Course Contents:
Module 1: Introduction Theories of Communication and Soft Skills (7L)
a. Communication and the Cyclic Process of Communication (Theory, benefits and application)
b. Introduction to Workplace Communication (Principles and Practice)
c. Non-Verbal communication and its application
c. Soft Skills Introduction: Soft-Skills Introduction
What is Soft Skills? Significance of Soft-Skills
Soft-Skills Vs. Hard Skills
Components of Soft Skills
Identifying and Exhibiting Soft-Skills (Through classroom activity)
Module 2: Active Listening (7L)
a. What is Active Listening?
b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
c.Differences between Listening and Hearing, Critical Listening, Barriers to Active Listening, Improving Listening.
d. Listening in Business Telephony and Practice
Practical (Role plays, case studies)
Module 3: Speaking Skills (7L)
a. Effective Public Speaking: Public Speaking, Selecting the topic for public speaking, (Understanding the audience, Organizing the main ideas, Language and Style choice in the speech, delivering the speech, Voice Clarity). Practical (Extempore)

Self Learning Topics: Preparation, Attire, Posture and Delivery techniques

b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation

c. Fluency-focused activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
d. Group Discussion: Principles, Do's and Don'ts and Practice;

Module 4: Writing and Reading Comprehension (7L)

a. Reading and Writing a Book Review (classroom activity)
b. Writing a Film Review after watching a short film (classroom activity)
c. Reading Strategies: active reading, note-taking, summarizing, and using visual aids like diagrams and graphs
d. Solving Company-Specific Verbal Aptitude papers.(Synonyms, Antonyms, Error Correction and RC Passages)

Module 5: Presentation Skills (8L)

Kinds of Presentation. Presentation techniques, planning the presentation,
Structure of presentation: Preparation, Evidence and Research, Delivering the presentation, handling questions, Time management, Visual aids.

- Self Introduction, Creation of Video Resume`
- Need for expertise in oral presentation.•Assignment on Oral presentation.
- Rules of making micro presentation (power point). Assignment on micro presentation

Text Books:

1. Pushp Lata and Sanjay Kumar. *A Handbook of Group Discussions and Job Interviews*. New Delhi: PHI, 2009.
2. Jo Billingham. *Giving Presentations*. New Delhi: Oxford University Press, 2003.
3. B. Jean Naterop and Rod Revell. *Telephoning in English*. 3rd ed. Cambridge: Cambridge University Press, 2004.
4. Jeyaraj John Sekar. *English Pronunciation Skills: Theory and Praxis*. New Delhi: Authorspress, 2025.
5. Career Launcher. *IELTS Reading: A Step-by-Step Guide*. G. K. Publications. 2028

Reference Books:

1. Ann Baker. *Ship or Sheep? An Intermediate Pronunciation Course*. Cambridge: Cambridge University Press, 2006.
2. Barry Cusack and Sam McCarter. *Improve Your IELTS: Listening and Speaking Skills.* London: Macmillan, 2007.
3. Eric H. Glendinning and Beverly Holmström. *Study Reading.* Cambridge: Cambridge University Press, 2004.
4.Malcolm Goodale. *Professional Presentations*. New Delhi: Cambridge University Press, 2005.
5. Mark Hancock. *English Pronunciation in Use*. Cambridge: Cambridge University Press, 2003.
6. Tony Lynch, *Study Listening*. Cambridge: Cambridge University Press, 2004.
7. J. D. O'Connor. *Better English Pronunciation*. Cambridge: Cambridge University Press, 2005.
8. Peter Roach. *English Phonetics and Phonology: A Practical Course*. Cambridge: Cambridge University Press, 2000.

2nd Year 3rd Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC301	EM Theory, Antenna & Propagation	3	0	0	3	3
2	ENGG	Major	EC302	Analog Electronic Circuits	3	0	0	3	3
3	ENGG	Major	EC303	Signals & Systems	3	0	0	3	3
4	ENGG	Minor	CS(EC)301	Data Structure & Algorithms	3	0	0	3	3
5	SCI	Minor	M(EC)301	Numerical Methods	2	0	0	2	2
A. PRACTICAL									
1	ENGG	Major	EC391	EM Theory & Antenna Propagation Lab	0	0	3	3	1.5
2	ENGG	Major	EC392	Analog Electronic Circuits Lab	0	0	3	3	1.5
3	ENGG	Minor	CS(EC)391	Data Structure & Algorithms Lab	0	0	3	3	1.5
4	HUM	Ability Enhancement Course	HU(EC)391	Technical Seminar Presentation & Group Discussion	0	0	3	3	1.5
C. MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	MC	MC381	S/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives		0	0	0	0
Total of Theory, Practical								26	20

Course Name: EM THEORY, ANTENNA & PROPAGATION
Course Code: EC301
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites:
The candidates should learn basic knowledge of vector calculus, electrostatic, magnetostatics.

Course Objectives:
1. To understand the basic properties of Plane wave propagation in different medium.
2. To learn EM wave propagation in transmission line.
3. To know the fundamentals of antenna and its characteristics.
4. To understand radio wave propagation phenomena in communication system.

Course Outcome:
Graduates of the ECE program will be able to:
CO1: Understand and apply Maxwell's equation to determine static fields and time-varying electromagnetic fields in different media.
CO2: Analyze various transmission lines for application in high-speed Digital design and signal integrity of PCBs.
CO3: Apply fundamentals of antenna theory to different types of antennas to determine their radiation properties.
CO4: Design basic antenna with EM simulation software.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1			2			2	2	1	1	2	
CO2	3	3	2	1	2	2	1			1	2	2	2	2	
CO3	2	2	1	3		3			2			2	1	2	
CO4	2	3		1		2	2			2	2	1	2	2	

Course Content:
Module I: Electrodynamics [10L]
Electric & magnetic boundary conditions between media interfaces, Review of time varying Maxwell's equation, magnetic vector potential, Helmholtz's equation, plane wave in lossy dielectric, free-space, lossless dielectric, good conductor: skin depth, surface resistance.; Poynting theorem, reflection of plane waves at normal and oblique incidence; diffraction and scattering phenomena.

Module II: Transmission Line [12L]
Concept of lumped parameters, transmission line equation & their solution, propagation constant, characteristic impedance, wavelength, velocity of propagation for distortion less line and loss-less line; reflection and transmission coefficients, standing wave, VSWR, input impedance; Smith chart; some impedance techniques- quarter wave matching, matching with lumped

elements (L-networks), T-line in time domain, lattice diagram calculation, pulse propagation on T-line.

Module III: Antenna & wave propagation [12L]
Antenna characteristics: radiation pattern, beamwidth, radiation efficiency, directivity, gain, efficiency, input impedance, polarization, effective area; Friis transmission equation. Radiation characteristics of Hertzian dipole antenna.
Properties and typical application: - half-wave dipole, monopole, loop antenna, parabolic & corner reflector antenna, micro-strip patch antenna, array: Yagi-Uda, log-periodic.

Module IV: Application of antenna [2L]
Design of Antenna with EM software for specific applications: e.g micro-strip patch antenna design for hand-held application.

Text books:
1. Principles of Electromagnetics, 6th Edition, Matthew O H Sadiku, Oxford University Press.
2. Antenna Theory: Analysis & Design, Constantine A. Balanis; Wiley, 4th Edition.
3. Electromagnetics with applications, 5th ed, J. D. Kraus and D. Fleisch, McGraw Hill,1999.

Reference Books:
1. Engineering Electromagnetics, Hayt and Buck,7th edition, McGraw Hill.
2. Fields & Wave in Communication Electronics, S. Ramo, J.R. Whinnery& T. Van Duzer, John Wiley.
3. Electromagnetics, 2ed Edition– JA Edminister, Tata-McGraw-Hill.
4. Engineering Electromagnetics, 2ed Edition- NathanIda, Springer India.

Subject Name: Analog Electronic Circuit
Subject code: EC302
Contact Hour/Week: (3L:0T:0P)
Credit: 3
Total Contacts: 36

Prerequisites: Basic knowledge about components (R, L, C). Network Theorems (Kirchhoff's law, Theremin's theorem, Norton's theorem, etc.). Basic knowledge about the operation of semiconductor devices (Diode, BJT, JFET, etc.), Basic knowledge of Differentiation, Integration, and Differential equations.

Course Objectives: Students will learn to design, test, and examine simple circuits with diode, transistor, op-amp, etc. They will have clear knowledge of basic circuit analysis and its functions and their limitations. Most importantly, they will be able to understand, modify, and repair the majority of circuits used in professional equipment design. They will also be able to take up new design exercises.

Course Outcomes (COs)

Graduates of the ECE program will be able to:

CO1: Design small and large signal amplifiers using the BJT and FET.
CO2: Implement the feedback concept in different amplifiers and oscillators.
CO3: Analyze the performance of small and large signal amplifiers.
CO4: Design various applications using OP-AMP and multivibrators.

CO-PO mapping

Course

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	-	-	-			
CO2	2	3	3	3	2	-	-	-			
CO3	3	2	3	3	2	-	-	-			
CO4	3	3	3	3	3	-	-	-			

Content:

Module I (9L)
BJT Biasing: Thermal Runaway, Load line; Q-point, Stability Factor, Fixed Bias Circuit, Self-Bias Circuit – Working Principle, Stability factor calculation

Bias Compensation using a thermistor.
Small Signal Analysis using π model in CE configuration; calculation of Voltage gain, input/output impedance.

Hybrid π model (Basic idea)

Multistage amplifier: Frequency response overview.
Coupling techniques: RC, Transformer-coupled.
Introduction to Emitter Follower

Module II (6L)

Power Amplifiers: Class A, B, AB- Working Principle; Efficiency Calculation
Tuned Amplifier- Working Principle; Q Factor
JFET Amplifiers: Biasing (Fixed, Self, Divider), Configurations (CS, CD, CG).
MOSFET Amplifiers (Common Source and Common drain amp. Basic idea)

Module III (5L)

IC-555 based: Astable, Monostable, and Bistable multivibrators.(Working principle with Timing diagram)
Calculation of Duty Cycle(for Astable) and Pulse Width (for Monostable)

Module IV (6L)

Feedback Concept: Negative and Positive.
Feedback topologies and effect on input/output impedance. Barkhausen criterion.
Oscillators: RC (Phase Shift, Wien Bridge), LC (Colpitts, Hartley), Crystal Oscillator – Working principle, output frequency calculation

Module V (10L)

BJT-based Differential Amplifier.
Op-Amp Characteristics (Ideal & Non-Ideal), Internal Diagram.
Applications: Inverting/Non-Inverting, Summing, Differential, Integrator, Differentiator.
Comparator, Log and Anti log Amplifier, Rectifier, Voltage Comparator, Schmitt Trigger.
Active Filters: Low-pass, High-pass, Band-pass.

Instrumentation Amplifier (Basic idea)

Textbooks:

Sedra & Smith -Microelectronic Circuits - Oxford Up
Millman & Halkais- Integrated Electronics, McGraw-Hill.
Boylested & Nashelsky-Electronic Devices and Circuit Theory-Pearson/PHI
Rashid-Microelectronic Circuits-Analysis and Design- Thomson (Cenage Learning).
Franco- design with Operational Amplifiers & Analog Integrated Circuits, 3/e, McGraw-Hill.
Gayakwad R.A – OPAmps and Linear IC's, PHI

Reference Books :

Razavi- Fundamentals of Microelectronics -Wiley
J.B. Gupta- Electronic Devices and Circuits- S.K. Kataria & Sons
Malvino- Electronic Principles, 6/e, McGraw-Hill

Subject Name: Signals & Systems
Subject Code: EC 303
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36
Semester: 3rd

Course Objectives:

1. To explain the basic properties of signals & systems and the various methods of classification.
2. To define the Fourier series, Fourier transform, Laplace and Z transform and their properties.
3. To illustrate LTI systems and random processes.

Course Outcome:

CO1: Classify different types of signals based on properties for effective signal characterization. Analyze signal representation and perform mathematical operations like shifting, scaling, convolution, and correlation for signal manipulation and processing.

CO2: Classify different types of systems based on properties such as linearity, causality, time-invariance, and stability for effective system characterization.

CO3: Apply Fourier analysis techniques to compute Fourier series for spectral analysis and energy distribution evaluation in signals.

CO4: Apply Fourier analysis techniques to compute Fourier transforms for spectral analysis and energy distribution evaluation in signals.

CO5: Sampling theorem, Utilize Laplace and Z-transforms to analyze system behavior, determine system stability, and compute inverse Z-transforms for system response evaluation in the z-domain.

CO6: Evaluate random variables and statistical properties of signals using probability distributions and statistical measures like mean, variance, and standard deviation for signal behavior analysis in practical applications.

Prerequisites:

The candidates should learn mathematics and basic knowledge of differential equations, difference equations and Laplace Transform.

Module I Introduction to Signals ***[8L]***

Introduction to Signals - Definition and properties, Singularity Functions and Some Elementary

Signals. Representation of signals using graphical, tabular and sequential form, Operations on signals.

[2L]

Classification of signal - Deterministic and Random signals, Periodic and Aperiodic signals, Continuous time and discrete time signals, Continuous valued and Discrete valued signals, Multi-channel and Multi-dimension signals, Even and Odd signals, Causal, Non-causal and Anti-causal signal, Energy and Power Signals.
[3L]

Transformation of independent variables – Time shifting, time scaling, time reversal, scalar multiplication, signal multiplication, combined operations.

[2L]

Correlation of signals *- Cross-correlation, Auto-correlation, Computation of correlation, Correlation of power and periodic signals.*

[1L]

Module II

Introduction to system

[7L]

System *- Definition of system and properties, Classification of system - Linear & Non-linear systems, Causal, non-causal and anti-causal systems, Time variant & invariant systems, Stable and non-stable systems, Memory and without memory systems, Invertible and noninvertible systems.*

[4L]

Linear-time invariant (LTI) system - Definition and Classification – Continuous-time LTI systems and Discrete-time LTI systems, Continuous-time LTI systems – Unit impulse response, convolution integral and its properties, Discrete-time LTI systems – Convolution sum and its properties, convolution of two signals using graphical and matrix method. Relationship between LTI system properties and impulse response. **[3L]**

Module III

Fourier series of Continuous-time and Discrete-time Signals **[6L]**

Continuous-time Fourier series (CTFS) - Fourier series analysis and derivation of Fourier

Coefficients Equation (Exponential form only), CTFS Properties, Symmetry Properties of the Fourier Series, Diminishing of Fourier Coefficients, Dirichlet Conditions, Fourier Spectrum, Gibbs's Phenomena, Properties of CTFS, Parseval's relation (statement only), Problems on CTFS.

[3L]

Discrete-time Fourier series (DTFS) – Fourier series analysis and evaluation of DTFS coefficients, Magnitude and phase spectrum of DTFS, properties of DTFS, Parseval's relation (statement only), Problems on DTFS.

[3L]

Module –IV

Fourier Transformation of Continuous-time and Discrete-time Signals

[6L]

Continuous-time Fourier transformation (CTFT) – Definition and convergence, Importance, Relation with Fourier series, Examples, Computation of Fourier transform of different signals. CTFT properties of Fourier Transform - Linearity, Time shifting, Conjugation, Differentiation, Integration, Time scaling, Parseval's theorem, Duality, Convolution.

[2L]

Discrete-time Fourier Transform (DTFT) – Definition and convergence, CTFT properties of Fourier Transform - Linearity, Time shifting, Conjugation, Differentiation, Integration, Time scaling, Parseval's theorem, Duality, Convolution, Computation of DTFT of different sequences.

[2L]

Signal transformation through LTI systems, Ideal and practical filters, Signal Bandwidth, Relationship between bandwidth and Rise Time, Energy Spectral Density (ESD) and Power Spectral Density (PSD).

[2L]

Module V Signal Transforms

[6L]

Introduction to Laplace transformation (LT) – LT from prerequisites, Analysis and characterization of LTI systems using LT.

[1L]

Sampling Theorem - Representation of continuous time signals by its sample – Types of sampling, sampling theorem. Reconstruction of a Signal from its samples, aliasing – sampling of band pass signals.

[2L]

Introduction to Z-Transforms (ZT) - Definition, Relationship between DTFT and ZT, Unilateral and bi-lateral ZT, Properties of ZT, z-plane, Region of convergence (ROC), Properties of ROC, transfer function, concept of Poles and zeroes, Analysis and characterization of LTI systems using LT.

[2L]

Inverse Z-transform - Inverse Z-transform using residue theorem, power series expansion and partial fraction method.

[1L]

Module VI

Introduction to Random Variables

[3L]

Definition of Random Signal, Random Variables and Probability Distributions, Examples.

[1L]

Statistical Properties of Random Signal: Independent and conditional random variables, Standard Deviation, mean, variance, Examples.

[1L]

Independent and Dependent Random Variables, Arithmetic Mean.

[1L]

Text books:

1. Linear Signals and Systems by B.P. Lathi-OXFORD university Press
2. Signals &Systems by A.V. Oppenheim, A.S. Willsky and S.H. Nawab - Pearson
3. Signals and Systems by P.Ramesh Babu & R.Anandanatarajan - Scitech

References:

1. Signals &Systems by A.Anand Kumar-PHI
2. Signals and Systems by S.Haykin & B.V.Veen-John Wiley
3. Signals and Systems by A.Nagoor Kani- McGraw Hill
4. Signals and Systems by S Ghosh- Pearson
5. Digital Signal Processing by M.H.Hays- TMH

6. Signals and Systems by Salivahanan
7. Signals and Systems with MATLAB by Wŏn-yŏng Yang-Springer
8. Signals and Systems by A. Nagoor Kani- McGraw Hill
9. Digital Signal Processing by P.Ramesh Babu & R.Anandanatarajan - Scitech

Mapping of CO with PO:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	1	2	1	-	-	-	3	3	2	3
CO2	2	3	3	2	3	1	2	1	-	-	-	3	3	2	3
CO3	3	3	3	1	3	1	1	1	-	-	-	2	1	3	3
CO4	3	2	3	3	3	2	2	1	-	-	-	3	2	3	1
CO5	2	3	3	3	3	2	2	1	-	-	-	3	1	3	1
CO6	3	2	3	2	3	1	2	1	-	-	-	2	3	3	2

Course Name: Data Structures
Course Code: CS(EC)301
Contact (Periods/Week):=3L/Week
Total Contact Hours: 40
Credits: 3

Prerequisite: Basic Understanding of Programming language C (6L)

Course Outcomes	Name of Course Outcomes
CO1	To identify how the choices of data structure & algorithm methods impact the performance of program.
CO2	To express problems based upon different data structure for writing programs.
CO3	To implement programs using appropriate data structure & algorithmic methods for solving problems.
CO4	To explain the computational efficiency of the principal algorithms for sorting, searching, and hashing.
CO5	To write programs using dynamic and static data structures and building applications for real world problems.

CO-PO-PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1
CO 1	3	2		2	3						1
CO 2	3	2	2	2	2						
CO 3	2	3	3	2	3						1
CO 4	2	2	2	3	1						
CO 5	2	3	3	3	2						1

Module 1: Introduction
Data Structure and Data Type. Classification of Data Structures- Primitive and Non-Primitive Data Structure, Linear and Non-Linear Data Structure. Need of Data Structures. Concept of algorithms and programs, Different methods of representing algorithm; Algorithm analysis, time and space analysis of algorithms – Asymptotic notations like Big Oh (O), Small Oh(o), Big Omega(Ω), Small Omega(ω) and Theta(Θ) notation (definition and significance). (4L)

Module 2: Non-Restricted Linear Data Structure
List or Linear List: Definition and Example, List as ADT. Representation of Linear List- Sequential Representation and Linked Representation. Array: Introduction to sequential representation, Linearization of multidimensional array. Application of array- representation of polynomial using array, Representation of Sparse matrix using array. Linked List: Introduction to linked representation, Implementation of different types of linked list- Singly linked list, Doubly linked list, Circular linked list, Circular Doubly Linked List. Application of Linked list, Representation of polynomial. (9L)

Module 3: Restricted Linear Data Structure

Stack: Definition of Stack, implementations of stack using array and linked list, Applications of stack- infix to postfix conversion, Postfix Evaluation Recursion: Principles of recursion - use of stack, tail recursion. Tower of Hanoi using recursion. Queue: Definition of Queue; Implementation of queue using array-physical, linear and circular model; Implementation of queue using linked list. Dequeue - Definition and different types of dequeue.(6L)

Module 4: Nonlinear Data structures

Trees and Binary Tree: Basic terminologies; Definition of tree and binary tree. Difference between tree and binary tree, Representation of binary tree (using array and linked list) Binary tree traversal (pre-, in-, post- order); Threaded binary tree- definition, insertion and deletion algorithm; Binary search tree- Definition, insertion, deletion, searching algorithm; Height balanced binary tree: AVL tree- definition, insertion and deletion with examples only. m –Way Search Tree: B Tree – Definition, insertion and deletion with examples only; B+ Tree – Definition, insertion and deletion with examples only. Heap: Definition (min heap and max heap), creation, insertion and deletion algorithm. Application of heap (priority queue and sorting). (7L)

Module 5: Sorting and Searching

Sorting Algorithms: Definition and need of sorting, different types of sorting algorithm (internal, external, stable, in-place, comparison based); Factors affecting sorting Methods, Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort, Radix sort – algorithm with analysis (time complexity) Searching: Factors affecting searching Methods; Sequential search –algorithm with analysis (time complexity); improvement using sentinel. Binary search and Interpolation Search algorithm with analysis (time complexity) Hashing: Introduction and purpose of Hashing and Hash functions (division, folding and mid-square), Collision resolution techniques.(8L)

<u>Text/ Reference book:</u>

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications
2. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2 nd Edition, Universities Press R-23 B. Tech CSE
3. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition, Pearson.
4. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited 5. Data Structures and Program Design in C by Robert L. Kruse, Bruce P. Leung 2 nd Edition, Pearson 4. Data Structures in C by Aaron M. Tenenbaum, 1 St Edition, Pearson.

Course Name: Numerical Methods
Course Code: M(EC)301
Contact: 3:0:0
Total Contact
Hours: 24
Credit: 2

Prerequisite:

The students to whom this course will be offered must have the concept of (10+2) standard number system, algebra and calculus and basic knowledge of numerical analysis.

Course Objectives:
This course aims to enhance comprehension of numerical methods and finite precision arithmetic by applying them to solve engineering problems. Through this study, students will gain a deeper understanding of the derivation of a practical application of numerical techniques in addressing real-world engineering challenges.

Course Outcomes (COs):
On successful completion of the learning sessions of the course, the learner will be able to:

CO	DESCRIPTIONS
CO1	Apply numerical methods used to obtain approximate solutions of intractable mathematicalproblems such as the solution of linear and nonlinear equations, and the solution of ordinaryand partial differential equations.
CO2	Compare numerical results in the context of the given problem, including limitations andadvantages, through reports and presentations.
CO3	Apply numerical methods to obtain the solution of boundary value problems and initial valueproblems, showcasing an understanding of how numerical methods can be extended to address the real-world problems with specific boundary conditions and initial conditions.
CO4	Analyze the convergence rates of various numerical methods, understanding the underlyingprinciples that influence convergence behavior.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-			
CO2	3	2	-	-	-	-	-	-	-	-	-			
CO3	3	2	-	-	-	-	-	-	-	-	-			
CO4	3	3	-	-	-	-	-	-	-	-	-			

Course Content

MODULE I: ***Solution of Algebraic Polynomial and Transcendental Equations (8Lectures)***
Bisection method, Regula-Falsi, Secant method, Fixed Point Iteration method, Newton-Raphson method.

MODULE II: ***Matrix and Numerical Solution of System of LinearEquations (8 Lectures)***

Matrix: Eigenvalues and eigenvectors of matrix: Power method. ***(2Lectures)***

Numerical Solution of a System of Linear Equations: Gauss-Elimination method, LU Factorization method, Tridiagonal system, Gauss-Seidel iterative method. ***(6 Lectures)***

MODULE III: ***Numerical Solution of Differential Equation (8 Lectures)***

Numerical Solution of Ordinary Differential Equation: Taylor series method,Adams-Bashforth-Moulton and Milne's Predictor-Corrector methods, Finite Difference method. ***(5 Lectures)***

Numerical solution of partial differential equation: Finite Difference method, Crank–Nicolson method. ***(3 Lectures)***

Project Domains:

1. Application of PDE and ODE in Engineering Field.
2. Application of numerical methods for the relevant field.
3. Application of Dynamical system and Mathematical modeling.

Text Books:

1. Shishir Gupta & S. Dey, Numerical Methods, McGraw hill Education Pvt. Ltd.
2. C. Xavier: C Language and Numerical Methods, New age International Publisher.
3. Dutta & Jana: Introductory Numerical Analysis. PHI Learning
4. J. B. Scarborough: Numerical Mathematical Analysis. Oxford and IBH Publishing
5. Jain, M. K., Iyengar, S. R. K. and Jain, R. K. *Numerical Methods (Problems andSolution)*. New age International Publisher.
6. Prasun Nayek: Numerical Analysis, Asian Books

Reference Books:

1. Balagurusamy, E. *Numerical Methods*, SciTech. TMH.
2. Dutta, N. *Computer Programming & Numerical Analysis*, Universities Press.
3. Guha, S. and Srivastava, R. *Numerical Methods*, Oxford Universities Press.
4. Shastri, S. S. *Numerical Analysis*, PHI.
5. Mollah, S. A. *Numerical Analysis*, New Central Book Agency.
6. Numerical Methods for Mathematics, Science & Engg., Mathews, PHI.Rao, G. S. *Numerical Analysis*, New Age International.

Course Name: EM Theory and Antenna Propagation Lab
Course Code: EC391
Contact: 0:0:3
Credit: 1.5

Prerequisite:
The candidates should learn basic knowledge of vector calculus, electrostatic, magnetostatics.

Course Outcome:
After successful completion of this course, students should be able to:
CO1: To understand the theory of transmission lines in which EM wave propagate. CO2: Define and identify different types of transmission line, its characteristics in various load conditions.
CO3: To realize the fundamentals of antenna theory.
CO4: Demonstrate different types of antennas with their radiation mechanism. and design any one type of antenna using EM software.

List of Experiments:

Module I:
1. Familiarization of basic elements of the Transmission Line.
2. Plotting of Standing Wave Pattern along a transmission line when the line is opencircuited, short-circuited at the load end.
3. Unknown load Impedance of a terminated transmission line using shift in minima technique.
4. Study of parameters transmission line using Smith chart.
5. Study of electromagnetic phenomena of transmission lines in simulation software.

Module II:
6. Familiarization with antenna parameters measurement set-up and different antenna.
7. Radiation Pattern of dipole antenna and Mono-pole with ground plane.
8. Radiation Pattern of a folded-dipole antenna.
9. Radiation pattern of a Log-Periodic Antenna.
10. Beam width, gain and radiation pattern of a 3-element, 5-element and 7-element. YagiUda antenna – Comparative study.
11. Radiation pattern, Gain, Directivity of a Pyramidal Horn Antenna.
12. Design of microstrip patch antenna using software.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	1	-	-	-	1	-	-	-	1
CO3	3	1	1	1	-	-	-	-	-	-	-	-
CO3	3	2	-	1	-	-	-	-	-	-	-	2
CO4	2	3	-	-	1	2	1	-	-	-	-	1

Subject Name: Analog Electronic Circuit Lab
Subject code: EC392
Contact: 0:0:3
Credit: 1.5

Prerequisites: A basic course in Electronics and Communication Engineering. Progresses from the fundamentals of electricity, active and passive components, and basic electronics laws like Ohm's law.

Course Outcome: Graduates of the ECE program will be able to:

CO1: Design the BJT-based single-stage small and large signal amplifier.
CO2: Design the oscillator circuit.
CO3: Construct the timer circuit using IC 555.
CO4: Design the Integrator, differentiator, Schmitt Trigger and active filter circuit using OP-AMP

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	1	1	2	3	-	3
CO2	3	3	2	2	2	-	2	-	3	-	3
CO3	3	3	2	1	2	2	1	2	3	1	2
CO4	3	3	3	3	2	-	2	-	3	-	3

List of Experiments:

No.	NAME OF THE EXPERIMENT
1	**Design and analysis of RC-coupled amplifier in common-emitter (CE) mode using BJT** and study of its frequency response.
2	**Design and implementation of RC phase shift oscillator using BJT** and measurement of its output frequency.
3	Design a Class A Power Amplifier and calculate the efficiency.
4	Design a Class B Push Pull Power Amplifier and calculate the efficiency.
5	**Design and study of a single-stage voltage amplifier using JFET**
6	Design an Adderand & Subtractor Circuit using **OPAMP (IC-741)**
7	**Design of Integrator circuit using OPAMP (IC-741)** and analysis of its frequency response and application in waveform generation.
8	**Design of Differentiator circuit using OPAMP (IC-741)** and study of its response to different input signals.

9	**Design of Band-pass filter using OPAMP (IC-741)** and analysis of center frequency, bandwidth.
10	**Design of Schmitt Trigger circuit using OPAMP (IC-741)** and study of its transfer characteristics and hysteresis behavior.
11	**Design of an astable multivibrator using timer IC-555,** waveform observation, and measurement of frequency and duty cycle.
12	**Innovative experiment**

Course Name: Data Structures Lab
Course Code: CS(EC)391
Contact (Periods/Week): 3L/Week
Total Contact Hours: 36, Credits: 1.5

Course Content: Module 1: Implementing Non-Restricted Linear Data Structure [2 Lab]

Problem based on Implementation of Non-Restricted Linear Data Structure like- Implementation of list as data structure using array. Implementation of list as data structure using linked list of different types. Implementation of polynomial as data structure using array and linked list. Implementation of sparse matrix as data stricture using array.

Module 2: Implementing Restricted Linear Data Structure [3 Lab]

Problem based on Implementation of Restricted Linear Data Structure like- Implementation of stack as data structure using array. Implementation of stack as data structure using linked list. Implementation of queue as data structure using array (physic al, linear and circular model). Implementation of queue as data structure using linked list. Converting infix to post-fix and evaluating post-fix expression using stack. Implementing Tower-of-Hanoi problem.

Module 3: Implementing Non-Linear Data Structure [2 Lab]

Problem based on Implementation of Non-Linear Data Structure like Implementation of Binary Tree as data structure using array and linked list. Implementation of Binary Search Tree (BST) as data structure using linked list. Implementation of Heap as data structure using array. Implementation of Priority Queue as data structure using Heap.

Module 4: Implementing Sorting and Searching algorithm [5 Lab]

Problem based on Implementation of Sorting and Searching algorithm Implementation of Bubble sort using appropriate data structure. Implementation of Selection sort using appropriate data structure. Implementation of Insertion sort using appropriate data structure. Implementation of Quick sort using appropriate data structure. Implementation of Merge sort using appropriate data structure. Implementation of Heap sort using appropriate data structure. Implementation of Radix sort using appropriate data structure. Implementation of Sequential Search using appropriate data structure. Implementation of Binary Search using appropriate data structure. Implementation of hashing with collision resolution using linear and quadratic probing.

Course Outcomes	Name of Course Outcomes
CO1	To identify the appropriate data structure as applied to specified problem definition.
CO2	To summarize operations like searching, insertion, deletion, traversing mechanism used on various data structures.
CO3	To implement practical knowledge of data structures on the applications.
CO4	To illustrate how to store, manipulate and arrange data in an efficient manner.
CO5	To write programs to access queue and stack using arrays and linked list, binary tree and binary search tree.

CO-PO-PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	2	3	-	-	-	-	-	-
CO2	3	2	2	3	3	-	-	-	-	-	3
CO3	2	3	3	-	2	-	-	-	-	-	-
CO4	2	2	1	3	2	-	-	-	-	-	2
CO5	2	2	3	1	2	-	-	-	-	-	-
	2.4	2.4	2.4	2.3	2.4	-	-	-	-	-	2.5

Technical Seminar Presentation and Group Discussion
Code: HU(EC)391
Contact: 0:0:2Contacts: 2P
Credit: 1
Total no. of lectures: 12P

Prerequisite: Basic spoken English skills and presentation skills.Course Outcome
The Graduates of the IT program will be able to:

CO1: identify, define, apply workplace interpersonal communication modalities in aneffective manner.
CO2: employ, infer, relate group behavioral and personal interview skills.
CO3: organize, differentiate, employ reading proficiency skills.
CO4: identify, classify, organize and relate question types and aptitude test patterns inplacement tests.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	-	2	2	1	3	2	3	-
CO2	3	2	2	-	2	1	-	3	3	3	-
CO3	3	-	-	-	2	-	-	-	-	3	2
CO4	3	3	1	1	3	-	-	-	3	3	3

Course Content
Module 1: – Fundamentals of Technical Communication **3L**
1.The Skills of Technical Communication, 2. Team Behavior. 3. Time Management Skills
Module 2: - Verbal ability **3L**
1.Reading skill Development, Enhancing reading speed and vocabulary enhancement through intensive practice of placement test-based reading passages.

Module 3: Presentation Strategy **4L**

Presentation: Forms; interpersonal Communication; Classroom presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Module 4: – Group Discussion and Personal Interview **2L**

Basics of Group Discussion—Intensive practice on answering interview-based questions common in placement interviews.

List of recommended Books:

1. Meenakshi Raman and Sangeetha Sharma. Technical Communication. 3rd edition. NewDelhi: Oxford University Press, 2015.
2. Mark Ibbotson. Cambridge English for Engineering. Cambridge: Cambridge UniversityPress, 2008.
3. Mark Ibbotson. Professional English in Use: Engineering. Cambridge: Cambridge UP,2009.

Reference Books:

1. Lesikar. Business Communication: Connecting in a Digital World. New Delhi: Tata McGraw-Hill, 2014.
2. John Seeley. Writing Reports. Oxford: Oxford UniversityPress,2002.
3. Diana Booher.E-writing:21stCenturyTools for Effective Communication. Macmillan, 2007.
4. Michael Swan. Practical English Usage. Oxford: OUP, 1980.

2nd Year 4th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC401	Digital Electronics	3	0	0	3	3
2	ENGG	Major	EC402	Control Systems	3	0	0	3	3
3	ENGG	Major	EC403	Analog & Digital Communication	3	0	0	3	3
4	ENGG	Minor	IT(EC)401	Database Management Systems	3	0	0	3	3
5	ENGG	Minor	M(EC)401	Probability and Statistics	3	0	0	3	3
B. PRACTICAL									
1	ENGG	Major	EC491	Digital Electronics Lab	0	0	3	3	1.5
2	ENGG	Major	EC492	Control Systems Lab	0	0	3	3	1.5
3	ENGG	Major	EC493	Analog & Digital Communication Lab	0	0	3	3	1.5
4	ENGG	Minor	IT(EC)491	Database Management Systems Lab	0	0	3	3	1.5
C. MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	MC	MC481	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives	0	0	0	0	0
Total of Theory, Practical								27	21

Total Credit in 2nd Year- 41

Course Name: Digital Electronics
Course Code: EC401
Contact: 3:0:0
Total Contact Hours:36
Credits: 3

Prerequisites: A basic course in Electronics and Communication Engineering Progresses from the fundamentals of electricity, direct current (DC) devices and circuits, series and parallel circuits to the study of active and passive components, Ohm's Law, Kirchhoff's Law i.e. KVL, KCL, Ampere's Law etc.

Course Objectives:

• To present the Digital fundamentals, Boolean algebra and its applications in digital systems.

• To familiarize with the design of various combinational digital circuits using logic gates.

• To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits to explain the various semiconductor memories and related technology.

• To introduce the electronic circuits involved in the making of logic gates.

Course Outcome:

Students will be able to

CO 1	Acquire knowledge about solving problems related to number systems conversions and Boolean algebra and design logic circuits using logic gates to their simplest forms using De Morgan's Theorems; Karnaugh Maps.
CO 2	Design the combinational circuits like adder, subtractor, decoder, multiplexer based on the concept of logic gates (NAND, NOR, AND, OR, NOT).
CO 3	Analyze the timing properties (input setup and hold times, minimum clock period, output propagation delays) and design sequential circuits – flip flop, register, counter using the concept of combinational circuits.
CO 4	Demonstrate the working of ADC and DAC with the help of number system, resolution, speed of response up to 4 bits length data.
CO 5	Illustrate the equivalent circuits of the logic family - TTL, ECL, MOS and CMOS to realize logic functions based on the concept of BJT and MOSFET.

Course Content:

Module I: [8L]

Binary, Octal and Hexadecimal number system representation and their conversions; BCD, ASCII, EBDIC, Gray codes and their conversions. Signed binary number representation with 1's, 2's, 9'sand 10's complement methods, Binary arithmetic. Boolean algebra; Various Logic gates- their truth tables and circuits; Implementation of various logic Gates using Universal Logic Gate, Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-map method, Quine-McCluskey minimization technique (Tabular Method).

Module II: [9L]

Combinational circuits-Half Adder, Full Adder, Serial & Parallel Adder, Carry Look Ahead Adder, BCD Adder , Half Subtractor, Full Subtractor circuits, Adder-Subtractor Circuit. Encoder, priority encoder, Decoder, Multiplexer, De-Multiplexer, Adder & Subtractor Design using decoder &multiplexer, Boolean Function representation by MUX, Comparator and Parity Generator-Checker.

Module III: [11L]

Sequential Circuits-latch & FlipFlops-S-R,J-K,D and T, Conversion of FlipFlops, Various types of Shift Registers-SISO, PISO, SIPO, PIPO, Bi-directional & Universal Shift Register ,Modulus Counters-Synchronous, Asynchronous, Irregular, Self-Correcting Ring & Johnson Counter. Application of Counter (Stepper motor control), Finite state machine, state transition diagrams and state transition tables.

Module IV: [8L]

Parameters of D/A & A/D Converters. Different types of A/D -Flash Type, Successive Approximation and Dual Slope and D/A-R-2R Ladder & Binary Weighted Resistor Type. Logic families-TTL, CMOS, NMOS, PMOS & their operation and specifications. TTL Equivalent Circuit.

Textbooks:

1. A. Anand Kumar, Fundamentals of Digital Circuits-PHI
2. Morries Mano-Digital Logic Design-PHI
3. S. Salivahanan &S. Arivazhagan, Digital Circuit & Design-Bikas Publishing
4. A.K. Maini - Digital Electronics-Wiley-India

Reference:

1. Floyed &Jain- Digital Fundamentals-Pearson.
2. R.P. Jain—Modern Digital Electronics,2/e , Mc Graw Hill
3. H. Taub & D. Shilling, Digital Integrated Electronics-Mc Graw Hill.
4. D. Ray Chaudhuri-DigitalCircuits-Vol-I&II,2/e-Platinum Publishers
5. Kharate-Digital Electronics-Oxford
6. Tocci, Widmer, Moss- DigitalSystems,9/e-Pearson

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	1	1	1					2	2	1	2
CO2	3	3	1	3	1	1	1					1	3	2	3
CO3	3	3	1	3	1	1	1					2	3	3	3
CO4	3	3	1	3	1	1	1					1	3	2	3
CO5	3	3	1	3	1	1	1					2	3	2	3
AVG	3	3	1	3	1	1	1					1.6	2.6	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) =Not matched.

Subject Name: Digital Signal Processing
Subject Code: EC402
Credits: 3
Total Contact: 36

Course Objectives:

- **Understand** the fundamental concepts of discrete-time signals and systems, and their mathematical representations.
- **Analyze** the behavior of discrete-time systems in time and frequency domains using mathematical tools.
- **Develop** the ability to compute and interpret the Discrete Fourier Transform (DFT) and to use fast algorithms such as the Fast Fourier Transform (FFT) for efficient computation.
- **Design** and evaluate digital filters (FIR and IIR) to meet given specifications for real-world signal processing applications.
- **Explore** the effects of finite word-length and quantization in digital systems and learn methods to mitigate them.
- **Implement** DSP algorithms and filters using software tools (e.g., MATLAB, Python) and understand the basics of real-time DSP hardware implementation.

Course outcomes:

COs	After the completion of the course Students will be able to
CO 1	Apply the concepts of DFT and FFT including circular convolution, signal flow graphs, and Radix-2 algorithms to analyze discrete-time signals efficiently.
CO 2	Design and implement FIR and IIR digital filters using various structures and transformations for filtering and system realization.
CO 3	Analyze the effects of finite word length on digital filters in terms of quantization errors and limit cycle oscillations to ensure accurate digital system design.
CO 4	Evaluate different filter design techniques using Butterworth, Chebyshev, and various window functions to meet specific frequency response characteristics.
CO 5	Demonstrate the application of DSP in real-time systems through the study of DSP hardware, sub-band coding, and speech signal processing.

PREREQUISITE:

Students should be familiar with fundamental mathematical concepts such as calculus (limits, differentiation, integration, and series), linear algebra (vectors, matrices, and basic operations), and basic probability. A thorough understanding of signals and systems is required, including continuous-time and discrete-time signals, system attributes such as linearity, time-invariance, causality, stability, and the idea of convolution. Frequency-domain analysis requires knowledge of transform techniques such as the Fourier series, Fourier transform, Laplace transform, and Z-transform.

MODULE – I: DFT and FFT

[10]

DFT and IDFT: Properties of DFT, Twiddle factors, multiplication of DFTs, Circular & matrix convolution, DFT/IDFT and matrix methods' Filtering of long data sequences: Overlap-Save and Overlap-Add methods. Parseval's Identity. Difference between DFT and FFT.

Algorithm: Radix-2 algorithm, Decimation-In-Time, Decimation-In- Frequency algorithms, signal flow graphs Butterflies, Bit reversal.

MODULE – II Design of Digital Filters

[18]

A. Introduction to Digital Filters

- Moving average system, Autoregressive system, Pole-zero system, Non-recursive and recursive structures.
- Overview of digital filters: FIR vs IIR filters.
- Advantages & applications of digital filters.
- Characteristics of ideal and practical filters.
- Frequency response specifications: passband, stopband, ripple, and attenuation.
- Realization of Filters using Direct form –I, II, transposed structure, Cascade & Parallel Form, Factors influencing the choice of structure.

B. Infinite Impulse Response (IIR) Filter Design

- Characteristics of IIR filters
- Analog filter approximations (Butterworth, Chebyshev filters)
- Conversion of analog filters to digital:
    - Impulse Invariant Transformation
    - Bilinear Transformation
- Frequency pre-warping & mapping of frequency response
- Comparison of design methods

C. Finite Impulse Response (FIR) Filter Design

- Characteristics of FIR filters
- Low pass FIR digital filters, High pass FIR digital filters, Bandpass FIR digital filters, Notch FIR digital filters, difference equations.
- Concept of Symmetric & anti-Symmetric FIR Filter
- Linear-phase FIR filters and their types
- Windowing techniques:
    - Rectangular, Triangular, Raised Cosine, Hanning, Hamming, Blackman and Kaiser windows
    - Trade-offs between main-lobe width and side-lobe levels
- Frequency sampling method
- Comparison of FIR and IIR filters

D. Frequency Transformation Techniques

- Transformation of low-pass filters to high-pass, band-pass, and band-stop.
- Frequency transformations in digital domain.

MODULE – III: Finite Word Length Effects in Digital Filters

[5]

Sources of finite word length effects: Coefficient quantization, Input/output quantization, Round-off and truncation errors, Accumulation of errors, Limit cycles, Zero- input Limit cycle Oscillations, Dead band, limit cycle Oscillations.

MODULE – IV: Application of DSP

[3]

Introduction to DSP Hardware TMS320C 5416/6713 processor. Concept of Sub-band coding, Speech analysis.

TEXT BOOKS:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis & D.G. Manolakis, Pearson Ed.
2. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co.
3. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
4. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co.

REFERENCE BOOKS:

1. Digital Signal Processing; Spectral Computation and Filter Design Chi-Tsong Chen, Oxford University Press
2. Texas Instruments DSP Processor user manuals and application notes

Mapping of POs with COs:

	P O1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11
CO1	3	3	1	2	-	3	-	2	2	2	1
CO2	2	3	2	1	2	2	-	2	2	-	2
CO3	3	2	1	3	-	3	1	3	1	1	1
CO4	3	3	-	2	-	-	1	1	1	2	2
CO5	2	3	3	-	3	3	2	3	3	2	1

Course Name: Analog and Digital Communication
Course Code: EC403
Contact: 3:1:0
Total Contact Hours: 36
Credit: 3

Prerequisite: Trigonometric Fourier series, Exponential Fourier series, Fourier transform and its properties, Energy and power signal, Probability and Statistics.

Course Objectives:
1. To introduce the concepts through various issues related to analogue communication such as modulation, demodulation, transmitters and receivers and noise performance.
2. To present the fundamentals of modern digital communication system design and to evaluate the performance of digital signaling schemes on realistic communication channels.
3. To elaborate the concept on physical layer digital communications, including waveform analysis, transmitter design and receiver design.

Course Outcome: Graduates of the ECE program will be able to:
CO1: Demonstrate the importance of AM and Angle modulation and demodulation schemes.
CO2: Analyse probability and random process in signal transmission.
CO3: Describe the concepts of sampling, Pulse Modulation techniques, different types of Source encoding techniques and their properties.
CO4: Analyse signal vector representation of various digitally modulated signals by using Signal constellation.
CO5: Illustrate various types of coherent digital modulation techniques and calculate their error Probabilities.

Mapping of CO with PO:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	3	3	2	3	1	2	1	-	-	3
CO2	2	3	3	2	3	1	2	1	-	-	3
CO3	3	3	3	1	3	1	1	1	-	-	2
CO4	3	2	3	3	3	2	2	1	-	-	3
CO5	3	2	3	2	3	1	2	1	-	-	2

Course Content:

MODULE I: Introduction to Analog Communication [9L]:

Elements of communication system - Transmitters, Transmission channels & receivers, Concept of modulation, need of modulation, Review of Fourier Transform, concept of Frequency translation, Frequency domain representation of signals, Principles of Amplitude Modulation (DSB-FC): Modulation index, Power content and bandwidth requirement,- DSB-SC & SSBSC(Balanced Modulator for DSB-SC, Phase Shift method for SSB-SC), VSB modulations and demodulation, AM demodulator: Synchronous detection for DSB-SC, Super Hetero Dyne receiver, Image frequency, Angle Modulation: Single Tone expression for FM and PM, modulation index of FM, concept of direct and indirect method of FM generation, NBFM and WBFM, FM modulator : Armstrong method, FM demodulator : PLL

MODULE-II: Random Processes: [4L]

Review of probability and random process. Gaussian and white noise characteristics, Rayleigh's energy theorem, Parseval's theorem, Fourier transform pair Power spectral density vs Autocorrelation likelihood functions.

MODULE-III: Pulse modulation: [6L]

Basic block diagram of Digital Communication system, advantages of digital communication system over analog communication system, sampling theorem. Quantization, quantization error Pulse modulation techniques: PAM, PWM, PPM. Line coding, Inter symbol Interference and Nyquist criterion, Source encoding: Pulse code modulation (PCM), Differential Pulse code Modulation (DPCM); Delta modulation; Adaptive Delta Modulation, concept of Time Division multiplexing & Frequency Division multiplexing, PCM-TDM.

MODULE-IV: Signal Vector Representation: [7L]

Analogy between signal and vector, distinguishability of signal, orthogonality and orthonormality, basis function, orthogonal signal space, message point , signal constellation, geometric interpretation of signals, Schwartz inequality, optimum correlation receiver; probability of error, error function, complementary error function, matched Filter.

MODULE-V: DIGITAL MODULATION TECHNIQUES: [10L]

Types of Digital Modulation, coherent ASK, FSK and PSK, geometrical representation of ASK; BPSK and BFSK signal, error probability of ASK; BPSK and BFSK, generation and detection of ASK; BPSK and BFSK Signal, power spectrum of ASK; BPSK and BFSK, Concept of M-ary Communication, M-ary phase shift keying, the average probability of symbol error for coherent M-ary PSK, power spectra of MPSK, Quadrature Phase Shift Keying (QPSK), error probability of QPSK signal, generation and detection of QPSK signals, power spectra of QPSK signals, basic concept of Offset (OQPSK) vs. Non-offset (NOQPSK) Quadrature Phase shift keying, QAM, Minimum Shift Keying (MSK), signal constellation of MSK waveforms.

TEXT BOOKS:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Principles of Communication Systems, H. Taub and D. Schilling, TMH Publishing Co.
3. Wireless Communication and Networks: 3G and Beyond, I. Asha Misra, TMH Education.
4. Communication Systems, A. Bruce Carlson, Paul B. Crilly TMH Education.

REFERENCE BOOKS:

1. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
2. Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, Oxford University Press.
3. Digital Communication, A. Bhattacharya, TMH Publishing Co.
4. Digital Communications by Dr. Sanjay Sharma S K Kataria and Sons

Name of the Paper: Database Management System
Paper Code: IT(EC)401
Contact (Periods/Week): 3:0:0 C
Credit Point: 3 No. of Lectures: 36

Course Outcomes:
On successful completion of the learning sessions of the course, the learner will be able to

CO1: To Express the knowledge of data models.
CO2: To Implement the concept of designing an efficient relational database system.
CO3: To Correlate real world queries with database system.
CO4: To Illustrate transaction processing, concurrency control and recovery management of a database.
CO5: To Assess the internal storage structure to implement a proper database for an organization.

Prerequisite:
1. Logic of programming language
2. Basic concepts of data structure and algorithms

Module 1: Introduction [3L]
Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.
Module 2: Entity-Relationship and Relational Database Model [11L]
Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database.
Module 3: SQL and Integrity Constraints [6L]
Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.
Module 4: Relational Database Design [8L]
Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF, Case Study
Module 5: Internals of RDBMS [9L]
Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking, Dead Lock handling.
Module 6: File Organization & Index Structures [6L]
File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CS502.1	3	3	3	3	3	2	-	-	3	-	-
CS502.2	3	3	3	2	3	2	-	-	2	-	-
CS502.3	3	3	3	3	3	-	-	-	2	-	-
CS502.4	2	2	2	2	3	1	-	-	2	-	-
CS502.5	3	2	2	2	3	1	-	-	1	-	-

Text / Reference Books:

1. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, McGraw Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. “Fundamentals of Database Systems”, Ramez Elmasri, Shamkant B. Navathe, Addison Wesley Publishing.
4. Ramakrishnan: Database Management System, McGraw-Hill

COURSE NAME: PROBABILITY AND STATISTICS

COURSE CODE: M(EC) 401

CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36

CREDITS: 3

Prerequisites:

The students to whom this course will be offered must have the concept of (10+2) standardMathematics.

Course Objectives:

The objective of this course is to disseminate the prospective engineers with the knowledgeof probabilistic approaches and applied statistics.

Course Outcome(s):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Recall the properties related probability distribution and applied statistics.

CO2: Explain the theoretical working of the concepts of probability distribution and appliedstatistics.

CO3: Apply the appropriate mathematical tools using the concepts of probability distribution andinferential statistics in Communication Science.

CO4: Analyze the real-world problems using the underlying principles of both probabilistic andstatistical approaches.

CO-PO Mapping:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-

Weightage Values: Strongly mapped: ‘3’, Moderately mapped: ‘2’, Weakly mapped: ‘1’,Not mapped: ’-‘.

Course Content:

Module-I: Probability and Random Variables **[10L]**

Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, Moments, Moment generating functions, Binomial, Poisson and Normal distributions

Module-II: Two Dimensional Random Variables **[9L]**

Joint distributions, Marginal and conditional distributions, Covariance, Correlation and linear regression, T Transformation of random variables, Central limit theorem (for independent and identically distributed random variables).

Module-III: Sampling Theory & Estimation of Parameters **[10L]**

Sampling Theory: Random sampling, Parameter & Statistic, Standard error of statistic, Distributions of the sample mean and the sample variance for a normal population, Chi-Square distributions, t distributions.

Estimation of Parameters: Unbiased and consistent estimators, Point estimation, Interval estimation, Maximum likelihood estimation of parameters (Binomial, Poisson and Normal), Confidence intervals and related problems.

Module-IV: Testing of Hypothesis **[7L]**

Simple and Composite hypothesis, Critical region, Level of significance, Type I and Type II errors, one sample and two sample tests for means and proportions, 32 - test for goodnessof fit.

Text Books:

1. Das, N.G, *Probability and Statistics*, The McGraw Hill Companies.
2. Gupta S. C. and Kapoor V. K., *Fundamentals of Mathematical Statistics*, Sultan Chand &Sons.
3. Goon A.M., Gupta M. K. and Dasgupta, B., *Fundamental of Statistics*, The World PressPvt. Ltd.
4. Kreyszig, E., *Advanced Engineering Mathematics*, 9^{th}Edition; John Wiley & Sons, 2006.

Reference Books:

1. Lipschutz, S.and Lipson, M., *Schaum's Outline in Probability* (2^{nd}Ed.); McGraw HillEducation.
2. Soong, T. T., *Fundamentals of Probability and Statistics for Engineers*; Wiley Publications.
3. Spiegel, M. R.,*Theory and Problems of Probability and Statistics (Schaum's Outline Series)*;McGraw Hill Book Co.
4. Montgomery, D.C. and Runger, G.C.,*Applied Statistics and Probability for Engineers*,Wiley Publications.

Course Name: Digital Electronics Lab
Course Code:EC491
Contact: 0:0:3
Credit:1.5
Prerequisites: A basic course in Electronics and Communication engineering Progresses from the fundamentals of electricity, active and passive components, basic electronics laws like Ohm's law, Ampere's law.
Course Outcome:

Subject Code	EC 391
COs	STUDENTS ARE:
CO 1	Able to understand the structure of various types of logic gates using different laws of Boolean algebra to verify the truth table.
CO 2	Able to design digital combinational circuits such as Encoder Decoder, adder subtractor, multiplexer demultiplexer using TTL/MOS technology to verify digital logic design.
CO 3	Analyze the timing properties (input setup and hold times, minimum clock period, output propagation delays) and design various and sequential circuits using Various switching speed, throughout/latency, gate count such as flip-flop, counter, register and area energy dissipation and power to validate functional operation of digital circuits.
CO 4	Analyze different TTL logic using different digital ICs to ensure functionality.
CO 5	Able to demonstrate the working of ADC and DAC with the help of number system, resolution, speed of response up to 4 bits length data.

List of Experiments:

1. Realization of basic gates and universal logic gates .
2. Design the circuit of Grey to Binary and vice versa.
3. Design a circuit for BCD to7-segment display.
4. Design of Half Adder &Full Adder Circuit using Logic Gates.
5. Design Half Subtractor &Full Subtractor Circuit using Logic Gates.
6. Four-bit parity generator and Two-bit comparator circuits.
7. Construction of simple Encoder & Decoder circuits using logic gates.
8. Construction of simple Multiplexer & De Multiplexer circuits using logic gates.
9. Realization of RS,D, JK and T flip-flops using logic gates.
10. Realization of SISO/SIPO Register using flip-flops and logic gates.
11. Realization of synchronous Up/Down counters.
12. Realization of logic gates using TTL.

13. One Innovative design of Digital Circuits.

Textbooks:

1. A.Anand Kumar, Fundamentals of Digital Circuits-PHI
2. Morries Mano-Digital Logic Design-PHI
3. S.Salivahanan&S.Arivazhagan,DigitalCircuit&Design-BikasPublishing
4. A.K.Maini-Digital Electronics-Wiley-India

Reference:

1. Floyed &Jain- Digital Fundamentals-Pearson.
2. R.P.Jain—ModernDigitalElectronics,2/e ,McGraw Hill
3. H.Taub & D.Shilling, Digital Integrated Electronics-McGraw Hill.
4. D.RayChaudhuri-DigitalCircuits-Vol-I&II,2/e-Platinum Publishers
5. Kharate-Digital Electronics-Oxford
6. Tocci,Widmer,Moss- DigitalSystems,9/e-Pearso

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	1	1	1			1	3	3	1	1
CO2	3	3	3	1	3	1	1		1	1	1	3	2	3	3
CO3	3	3	3	3	3	2	2	1		1	2	3	3	3	3
CO4	3	3	3	3	3	2	2	1		2	1	3	3	3	3
CO5	3	3	3	3	3	1	2	1	2	2	2	3	3	3	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Subject Name: Digital Signal Processing Lab
Paper Code: EC492
Credits: 1.5
Total Contact: 35

Course Objectives:

- To provide hands-on experience in simulating and analyzing discrete-time signals and systems using software tools.
- To understand and implement fundamental DSP operations such as convolution, correlation, and sampling in a simulated environment.
- To perform frequency-domain analysis of signals using Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT).
- To design and evaluate digital filters (FIR and IIR) using simulation and study their characteristics.

- To observe and analyze the effects of finite word length and quantization in digital signal processing.
- To familiarize students with industry-standard software (e.g., MATLAB, Scilab, Python) for developing and testing DSP algorithms.
- To encourage students to apply DSP concepts to practical problems and develop confidence in solving real-world signal processing tasks through software simulation.

CourseOutcome:

CO	Details
CO1	Implement and analyze basic operations on discrete-time signals and systems such as convolution, correlation, and sampling using software tools.
CO2	Perform frequency-domain analysis of signals by computing and interpreting the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT).
CO3	Design and simulate digital filters (FIR and IIR), and analyze their magnitude and phase response using software simulators.
CO4	Develop proficiency in using industry-standard software (e.g., MATLAB, Scilab, Python) for simulating and testing DSP algorithms.
CO5	Apply DSP concepts and tools to solve real-world signal processing problems and effectively communicate the results.

List of Experiments:

1. Generations of some basic signals using software simulator.
1. Systems (CausalandNon_causal,Time-InvarientandTime-varientetc.) verification using MATLAB.
2. Z-transform of various sequences–verification of the properties of Z-transform
3. Convolutionoftwosequencesusinggraphicalmethodsandusingcommands-verificationofthe properties of convolution.
4. Circular convolution of two sequences using graphical methods and using commands, differentiation between linear and circular convolutions.
5. DFT using twiddle factors.
6. DFTs/IDFTs using matrix multiplication and alsousing commands.
7. Verifications of the different algorithms associated with filtering of long data sequences and Overlap –add and Overlap-save methods.
8. Butterworth filter design with different set of parameters.
9. FIR filter design using rectangular, Hamming and Blackman windows.
10. Frequency responses of anti-imaging and anti-aliasing filters.
11. Analyze biomedical signals (like ECG,EEG) using digital signal processing techniques to extra relevant information, perform filtering, and detect abnormalities.

Textbooks:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis & D.G.Manolakis, Pearson Ed.
2. Digital Signal Processing, S.Salivahanan, A.Vallabraj &C.Gnanapriya,TMH Publishing Co.
3. Digital Signal Processing, P. Ramesh babu, Scitech Publications

(India).
4. DigitalSignalprocessing–AComputerBasedApproach,S.K.Mitra,TMHPublishingCo.

Reference books:

1. DigitalSignalProcessing;SpectralComputationandFilterDesignChi-TsongChen,Oxford University Press
2. Texas Instruments DSP Processor user manuals and application notes

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11
CO1	2	3	2	1	1	1	-	1	-	1	-
CO2	2	2	3	1	1	-	-	1	-	-	-
CO3	2	1	1	3	-	1	1	3	1	1	1
CO4	3	1	-	2	-	1	1	1	1	2	2
CO5	2	1	3	-	3	1	2	3	3	2	1

Course Name: Analog & Digital Communication Systems Lab
Course Code: EC493
Contact: 0:0:3
Credit: 1.5
Prerequisites: Knowledge of signals and systems

Course Outcomes: Graduates of the ECE program will be able to:
CO1: Analyze the concept of Analog and Digital communication techniques and their applications.
CO2: Design Analog and Digital modulation/ demodulation method.
CO3: Calculate power requirements and bandwidth of AM and FM.
CO4: Conduct Analog and Digital Modulation using software simulation.
CO5: Develop digital communication circuit for voice communication.

Mapping of CO with PO:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	1	2	1	-	-	2
CO2	2	1	3	3	1	1	1	1	-	-	2
CO3	2	3	2	3	2	1	1	1	-	-	2
CO4	2	1	3	3	1	2	2	1	-	-	2
CO5	3	1	3	3	1	1	1	1	-	-	2

List of Experiments:
1. Measurement of output power with varying modulation index an AM signal (for DSBFC & DSB-SC).
2. Measurement of the demodulated output with varying modulation index of an AM signal (DSB- FC).

3. Measurement of modulation index of a frequency modulated signal & and find out bandwidth.
4. Design a PLL using VCO & to measure the lock frequency.
5. Study of any Analog Modulation through software simulation.
6. Study of Pulse modulation (PAM, PWM) and demodulation.
7. Study of PCM and demodulation.
8. Study of Delta modulator and demodulator.
9. Study of Adaptive Delta modulator and demodulator.
10. Study of ASK modulator and demodulator
11. Study of BPSK modulator and demodulator
12. Study of BFSK modulator and demodulator.
13. Study of QPSK modulator and demodulator.
14. Study of any Digital Modulation through software simulation.
15. Innovative project: Breadboard realization of digital communication circuit for voice communication

Textbooks:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Principles of Communication Systems, H. Taub and D. Schilling, TMH Publishing Co.
3. Wireless Communication and Networks: 3G and Beyond, I. Asha Misra, TMH Education.
4. Communication Systems, A. Bruce Carlson, Paul B. Crilly TMH Education.

Reference books:

1. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
2.Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, OxfordUniversity Press.
3. Digital Communication, A. Bhattacharya, TMH Publishing Co.
4. Digital Communications by Dr. Sanjay Sharma S K Kataria and Sons
5. Digital Communications, J.G.Proakis, TMH Publishing Co.
6. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
7.Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, OxfordUniversity Press.
8. Digital Communication, A. Bhattacharya, TMH Publishing Co.
9. Digital Communications by Dr. Sanjay Sharma S K Kataria and Sons
10. Digital Communications, J.G.Proakis, TMH Publishing Co.

Name of the Paper: Database Management System
Paper Code: IT(EC)491
Contact (Periods/Week): 3/week
Credit Point: 1.5

Course Outcomes:

On completion of the course students will be able to

CO1: Understand the basic concepts regarding database, know about query processing and techniques involved in query optimization and understand the concepts of database transaction and related database facilities including concurrency control, backup and recovery.

CO2: Understand the introductory concepts of some advanced topics in data management like distributed databases, data warehousing, deductive databases and be aware of some advanced databases like partial multimedia and mobile databases.

CO3: Differentiate between DBMS and advanced DBMS and use of advanced database concepts and become proficient in creating database queries.

CO4: Analyze database system concepts and apply normalization to the database.

CO5: Apply and create different transaction processing and concurrency control applications.

Prerequisite:

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Module 1: Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.)

Module 2: Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, represent attributes as columns, identifying keys) and apply the normalization techniques

Module 3: Creation of Tables using SQL- Overview of using SQL tool, Data types in SQL, Creating Tables (along with Primary and Foreign keys), Altering Tables and Dropping Tables

Module 4: Practicing DML commands- Insert, Select, Update, Delete

Module 5: Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, CONSTRAINTS etc., Practicing Sub queries (Nested, Correlated) and Joins (Inner, Outer and Equi).

Module 6: Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping, Practicing on Triggers - creation of trigger, Insertion using trigger, Deletion using trigger, Updating using trigger

Module 7: Procedures- Creation of Stored Procedures, Execution of Procedure, and Modification of Procedure, PL/SQL, Cursors- Declaring Cursor, Opening Cursor, Fetching the data, closing the cursor.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CS592.1	3	3	3	3	3	2	-	-	2	-	-
CS592.2	3	3	3	2	3	2	-	-	2	-	-
CS592.3	3	3	3	3	3	-	-	-	2	-	-
CS592.4	2	2	2	2	3	1	-	-	2	-	-
CS592.5	3	2	2	2	3	1	-	-	1	-	-

3rd Year 5th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
C. THEORY									
1	ENGG	Major	EC501	InformationTheory&Coding	3	0	0	3	3
2	ENGG	Major	EC502	Advanced Microprocessor & Microcontroller	3	0	0	3	3
3	ENGG	Major	EC503	Control System	3	0	0	3	3
4	ENGG	Major	EC504A	MobileCommunication& Network	3	0	0	3	3
			EC504B	Computer Architecture					
			EC504C	RF&MicrowaveEngineering					
			EC504D	Power Electronics					
5	ENGG	Minor	CS(EC)501A	Object Oriented Programming using JAVA	3	0	0	3	3
			CS(EC)501B	Introduction to Quantum Computing					
			CS(EC)501C	Cloud Computing					
			CS(EC)501D	Operating System					
D. PRACTICAL									
1	ENGG	Major	EC592	Advanced Microprocessor & Microcontroller Lab	0	0	3	3	1.5
2	ENGG	Major	EC593	Control System Lab	0	0	3	3	1.5
3	ENGG	Major	EC594A	Mobile Communication & Network Lab	0	0	3	3	1.5
			EC594B	Computer Architecture Lab					
			EC594C	RF & Microwave Engineering Lab					
			EC594D	Power Electronics Lab					
4	ENGG	Minor	CS(EC)591A	Object Oriented Programming using JAVA Lab	0	0	3	3	1.5
			CS(EC)591B	Introduction to Quantum Computing Lab					
			CS(EC)591C	Cloud Computing Lab					
			CS(EC)591D	Operating System Lab					
5	ENGG	Skill Enhancement Course	IT(EC)591	IT Workshop Lab (SciLab/Python/R/C++)	0	0	4	4	2

6	PRJ	Project	EC581	Mini Project	0	0	0	4	2
C.MANDATORYACTIVITIES/COURSES									
	Mandatory Course	MC	MC581	NSS/NCC/PhysicalActivities/ Meditation & Yoga /Club Activities/EnvironmentalProtectionInitiatives	0	0	0	0	0
Total of Theory, Practical								**35**	**25**

Course Name: Information Theory & Coding
Course Code: EC 501
Contact: 3:0:0
Total Contact Hours: 36
Credits:3

Prerequisite: Digital Electronics, probability Course Outcomes: Graduates of the ECE program will be able to

CO1 – Understand the concepts of information theory and various source coding techniques. CO2 – Calculate channel capacity and rate of information in the digital communication system. CO3 – Apply source coding techniques to compress and encrypt data.
CO4 – Implement various error detection and correction coding techniques in the communication system to solve problems.
CO5 – Design circuits for different error control coding techniques.

CO-PO mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	1							1
CO2	3	2	2	1							1
CO3	3	3	1	1	1				1		1
CO4	3	2	2	2							1
CO5	3	2	2	2							1

Course Content

Module 1: Source Coding [6L]
Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes. Shannon - Fano Coding.

Module 2: Channel Capacity and Coding [6L]
Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.

Module 3: Linear and Block Codes for Error Correction [8L]
Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block, Standard array and syndrome detection code, perfect codes, Hamming codes.

Module 4: Cyclic Codes [8L]
Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, decoding cyclic codes, Encoding and Decoding circuit

Module 5: Other Codes: [8L]
Convolutional Codes: Encoding, state diagram, Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, Viterbi decoding, examples of convolutional codes, Application of Information Theory and Coding in Cyber Security, and Coding in Machine Learning (Basic idea).

Text Books:
1. Information theory, coding and cryptography-Ranjan Bose; TMH.
2. Introduction to Error Control Codes –Salvatore Gravano, Oxford
3. Information theory, coding and cryptography–A Saha, S Mondal; Pearson

Reference Books:
1. Information and Coding- N Abramson; McGraw Hill.
2. Introduction to Information Theory- M Mansurpur; McGraw Hill.
3. Information Theory - R B Ash; Prentice Hall.
4. Error Control Coding- Shu Lin and D J Costello Jr; Prentice Hall.
5. Todd K Moon,- Error Correction Coding: Mathematical Methods and Algorithms, John Wiley & Sons

Subject Name: Advanced Microprocessor & Microcontroller
Subject code: EC502
Contact: 3:0:0
Credit: 3
Total Contacts: 36

Prerequisites: Knowledge in Digital Electronics.

Course Objectives: To equip individuals with the knowledge and skills needed to design and develop embedded systems, understand their architecture, and apply them in various real-world applications. This includes mastering assembly language programming, interfacing with peripherals, and creating solutions for complex control and signal processing tasks.

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: Understand the architecture, features, and functioning of microprocessors and microcontrollers.

CO2: Develop assembly language programs to solve basic computational and data manipulation problems.

CO3: Analyze and design memory interfacing techniques and interrupt mechanisms.

CO4: Demonstrate the ability to integrate microprocessors/microcontrollers with support ICs for simple system design.

Course Content:

Module 1: **8085 Microprocessor: [7L]**
Introduction to Microcomputer based system, Evolution of Microprocessor and microcontrollers and their advantages and disadvantages, Architecture of 8085 Microprocessor, Address / Data Bus Memory interfacing, IO interfacing, Stack and Subroutine, Delay Calculation, Interrupts of 8085 processor, classification of interrupts.

Module 2: Assembly language programming with 8085:[4L] Addition, Subtraction, Multiplication, Block Transfer, ascending order, descending order, Finding largest & smallest number, Look-up table etc. Programming using interrupts (programming using INTR is not required). Instruction set, Addressing mode, Timing Diagram.

Module 3: 8086 Microprocessor: [7L]
8086 Architecture, Pin details, memory segmentation, addressing modes, Familiarization of basic Instructions, Interrupts & Direct Memory Access, Memory interfacing, ADC / DAC interfacing, Pipeline Architecture, Minimum and Maximum mode of addressing, Queue operation.

Module 4: Assembly language programming with 8086: [4L]
Addition, Subtraction, Multiplication, Block, Transfer, ascending order, descending order, Finding largest & smallest number etc.

Module 5: 8051 Microcontroller: [8L]
Difference between processor and controller, features of 8051 microcontroller, 8051 architecture & Pin diagram, Memory organization, Direct and indirect Access of memory, SFR, PCON, SCON, TCON, TMOD, IE, IP, SBUFF serial data i/o, interrupts, Memory interfacing, ADC / DAC interfacing, Logical operations: Byte-level, bit-level, rotate and swap operations; Arithmetic operations: Flags, incrementing and decrementing, addition, subtraction, multiplication and division.

Module 6: Support IC chips: [6L]
8255, 8253 and 8251: Block Diagram, Pin Details, Modes of operation, control word(s) format. Interfacing of support IC chips with 8085, 8086, ADC /DAC interfacing, Interfacing of support IC chips with 8051.

Textbooks:

1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar, Penram International
2. The 8051 microcontroller - K. Ayala, Thomson
3. Microprocessors & interfacing – D. V. Hall, Tata McGraw-hill
4. Ray &Bhurchandi, Advanced Microprocessors & Peripherals, TMH
5. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley, Pearson
6. An Introduction to Microprocessor and Applications –Krishna Kant, Macmillan

References:

1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxford university press
2. 8086 Microprocessor –K Ayala, Cengage learning
3. The 8051 microcontrollers – Uma Rao and AndhePallavi, Pearson

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	1	-	-	-	-	-	-	1
CO2	2	3	2	1	-	-	-	-	-	-	3
CO3	3	2	2	3	2	-	-	-	-	-	2
CO4	2	3	3	3	-	-	-	-	-	-	1

Subject Name: Control Systems
Subject Code: EC 503
Credits: 3
Total Contact: 36

Pre-requisite: Concepts in electrical circuits (Studied in Basic Electrical), Fundamental conceptson Laplace Transformation (studied in Mathematics).

Course Objectives:
To introduce concepts of mathematical modeling, open loop and feedback control systems.

To employ time domain analysis to predict and diagnose transient performance parameters of different types of systems for standard input signals.

To understand the various techniques of stability analysis in the time and frequency domain.

To identify the needs of different types of controllers and compensators to meet the required dynamic response from the system.

Course Outcome: After completing the course, the student will be able to:

CO1: Understand mathematical models of physical systems and study their nature, configuration and relevant mapping into equivalent models.
CO2: Determine the time responses of different types of systems and time domain specifications.
CO3: Analyze and solve stability-related issues in time response, and stability analysis using root locus.
CO4: Evaluate the relative stability of control systems using frequency domain analysis.
CO5: Design controllers according to desired performance specifications.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	-	-	-	-	1	1	1
CO2	3	2	2	2	1	-	-	-	2	1	1
CO3	3	2	2	2	1	-	-	-	2	1	1
CO4	3	2	2	2	1	-	-	-	2	1	1
CO5	2	2	3	2	1	1	1	-	2	1	1

Course Content

Module I: INTRODUCTION TO CONTROL SYSTEMS &MODELLING[7L]
Basic Elements of Control System, Linear, Non-Liner and Discrete Time System (Introduction & Concept) Open loop and Closed loop systems – Differential equation on control system – About transfer function and its generation technique, Modelling of Electrical and mechanical systems - Block diagram reduction techniques - Signal flow graph, mason's gain formula.
Multistage amplifier: Frequency response overview.
Coupling techniques: RC, Transformer-coupled.
Introduction to Emitter Follower

Module II: TIME RESPONSE ANALYSIS [5L]
Time response analysis –Different input deterministic test response – Order and Type of the incorporation of the systems with time response: First Order Systems - Impulse and Step Response analysis of second order systems - Steady state errors and error constants.

Module III: STABILITY ANALYSIS [6L]
Routh -Hurwitz Criterion, Root Locus Algorithm, Construction of Root Locus, Effect of addition of pole and zero on the root locus, Application of Root Locus Diagram.

Module IV: FREQUENCY RESPONSE ANALYSIS [6L]
Concept of Frequency Response of a system, Bode Plot Computational Algorithm, Construction of Bode diagram, Polar Plot, Phase and gain margin, Nyquist Plot, Interpretation of Bode and Nyquist plot, Stability analysis using frequency domain specifications.

Module V: CLASSICAL CONTROL DESIGN TECHNIQUES [4L]
Introduction to P, PI, PD and PID Controllers. Introduction to lead, lag and lead-lag compensators.Realization of basic compensators, Cascade compensation in time domain and frequency domain.

Module VI: STATE SPACE ANALYSIS OF CONTINUOUS TIME SYSTEMS [6L]
Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solutions of state equations of LTI system, Conversion from state space model to transfer function model and vice versa, Stability analysis in state spaces: Concept of eigenvalues and eigenvectors, State transition matrix using Cayley-Hamilton theorem, Controllability and observability

Module VII: ADVANCED CONTROL SYSTEM AND ITS APPLICATION [2L]
Concept of Robust Control and Adaptive Control. Application of advanced control systems with application DAS and SCADA

Text Books:

1. AutomaticControlSystems8thedition–byB.C.Kuo2003–JohnWileyandson's,
2. ControlSystemsEngineering–byI.J.NagrathandM.Gopal,NewAgeInternational (P)Limited, Publishers, 2nd edition.
3. Control Systems– by Ramesh Babu

Reference Books:

1. Modern Control Engineering –by Katsuhiko Ogata–Prentice HallofIndia Pvt.Ltd.,3rdedition,1998.

Subject Name: Mobile Communication and Network Subject Code: EC504A
Credits: 3
Total Contact hours: 36
Prerequisite: Knowledge of Analog & Digital Communication

Course Outcomes:
Graduates of the ECE program will be able to:
CO1: Analyze the evolution and History of Wireless Technology
CO2: Illustrate basics of cellular technology for mobile communication
CO3: Compare different cellular concepts in advancement of wireless mobile communication with radio channels.
CO4: Facilitate wireless networks using mobile IP
CO5: Develop mobile networks in 5G key technologies with spectrum sharing and MIMO antennas.

Module I: Introduction [4L]
Overview of mobile radio communications and global mobile systems, Evolution of cellular radio and personal communication technologies, Cellular system generations: 1G, 2G, 3G, 4G, and 5G, Key differences between generations of mobile cellular technologies, Core technologies enabling 5G networks, Understanding 5G performance: speed, latency, and capacity, Implications of adopting 5G: Device requirements and specifications for 5G. Introduction to 6G and its anticipated key enablers.

Module II: CELLULAR CONCEPT [8L]
Limitations of conventional mobile system, Introduction to mobile cellular communication, concept of frequency reuse,cluster size, cellular system architecture, channel assignment strategies, call handoff strategies - hard handoff and soft handoff, prioritizing handoff; interference and system capacity, improving capacity in cellular systems — cell splitting, sectoring, microcell zone concept, Co-channel interference, Propagation effects - scattering,ground reflection, fading.

Module III: DIFFERENT MOBILE COMMUNICATION SYSTEMS [8L]
GSM services and features, system architecture, GSM radio subsystem, GSM channel types, location updating and call setup, WAP, SCSD, GPRS Networks architecture, EDGE, 3G W-CDMA; CDMA digital cellular standard (UMTS, IS-95).

Module IV:WIRELESS NETWORKS AND IP [8L]
Network definition and topologies. Advantages and application of Wireless LAN,WLAN technology— RFandIRwirelessLAN, diffuse,quasi diffuse and point-to point IR wireless LAN, IEEE802.11 architecture, Introduction to WI-FI, HIPERLAN2, Bluetooth — Bluetooth architecture. Introduction to Mobile IP, requirements, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimization, Reverse tunneling; Mobile ad-hoc networks — Routing, Destination sequenced distance vector, Dynamic source routing and Alternative metrics

Module V: MOBILE NETWORK IN 5G AND BEYOND [8L]

Introduction to Mobile IP, MIPV4 and MIPv6, requirements, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimization, Reverse tunneling; Mobile ad-hoc networks — Routing, Destination sequenced distance vector, Dynamic source routing and Alternative metrics, 5G Introduction and vision, Multi antenna Technologies: MIMO; software defined radio, adaptive multiple antenna techniques, radio resource management, QOS requirements. Small cells: Past, present, and future trends of cellular networks coverage and capacity of small cell networksInterference management, D2D architecture Towards IoT Spectrum Sharing. Massive MIMO: Point-to-pointMIMO, Virtual MIMO (relaying), multiuser MIMO MassiveMIMO.

TEXT BOOKS:

1. Wireless Networks: Applications and Protocols, T. S. Rappaport, Pearson Education
2. Wireless Communication and Networks : 3G and Beyond, I. SahaMisra, TMH Education.
3. Wireless Communications : Principles and Practice, T.S.Rappaport, PHI Learning.
4. Wireless Communications, A. Goldsmith, Cambridge University Press.
5. Wireless Communications and Networking, J.W.Mark and W. Zhuang, PHI.

REFERENCE BOOKS:

1. Mobile Cellular Telecommunications: Analog and Digital Systems by William C., Y. Lee; Tata McGraw Hill Publication.
2. Wireless Communications: Principles and Practice by Theodore S. Rappaport; Pearson/PHI Publication.
3. Wireless and Digital Communications by Dr. KamiloFeher; PHI Publication.
4. T L Singal ,“Wireless Communications ”, McGraw Hill Education.
5. Ad Hoc Wireless Networks: Architectures and Protocols-C. Siva ram Murthy and B.S. Manoj, 2004, PHI.
6. Modern Wireless Communications-Simon Haykin, Michael Moher, Pearson Education, 2005.
7. Wireless Communications and Networking, Vijay Garg, Elsevier Publications, 2007.
8. Wireless Communications-Andrea Goldsmith, Cambridge University Press, 2005.
9. Lee’s Essentials of Wireless Communications, MH Prof. Med/Tech.
10. Wireless Digital Communications: Modulations and Spread Spectrum Applications, K. Feher, Prentice Hall.

CO-PO mapping:

CO	PO1	PO	PO	PO	PO	PO6	PO7	PO8	PO9	PO10	POll
CO1	3	2	-	2	-	2	-	-	-	-	2
CO2	3	2	1	-	1	-	-	-	1	-	-
CO3	3	3	-	2	2	-	-	-	1	-	-
CO4	3	2	2	-	2	-	-	1	-	1	-
CO5	3	3	3	2	2	2	-	2	-	2	2

Subject name: Computer Architecture
Subject code: EC504B
Credit: 3
Total Contact Hours: 36
Prerequisites: Digital Electronics, Analog Electronics, Microprocessor and Microcontroller, Sensors
Course Objectives:
The course objectives are commonly associated with computer architecture:
Describe Instruction Set Architecture (ISA), Examine Memory Hierarchy, and Understand Basic Computer Components Examine computer arithmetic, analyse performance metrics, apply concepts of parallel processing, learn about emerging technologies, build problem-solving skills, Study processor organization and critically evaluate architectural choices. By completing these goals, students should bearable to analyse, design, and optimize computer systems in addition to having a thorough understanding of computer architecture, ranging from fundamental ideas to more complex ideas. For students to meet the required learning outcomes, instructors must create assessments and activities that are in line with these goals.
Course Outcomes (COs):
After completing the course, the student will be able to:
CO1: Recall the fundamental components of a computer system, including the CPU, memory, and input/output devices. List the various types of memory found in a computer system.
CO2: Describe the instruction set architecture (ISA) concept and its role in computer organization. Summarize the pipelining principles and their impact on instruction execution.
CO3: Apply the knowledge of binary and hexadecimal number systems to represent data in a computer. Create a simple instruction set for a fictitious computer architecture.
CO4: Assess the benefits and drawbacks of parallel processing in computer architecture. Examine the effect of memory hierarchy on overall system performance.
CO5:Design a basic computer system, considering the organization of the CPU, memory, and input/output systems. Propose improvements to a given computer architecture to enhance performance.
CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	2	-	2	-	-	-	-	3
CO2	-	2	-	3	-	1	-	-	-	-	3
CO3	2	-	3	-	2	-	3	-	-	-	3
CO4	3	-	1	-	-	-	2	-	-	-	3
CO5	3	-	2	-	-	2	1	-	-	-	3

Modules:
Module 1: Basic Structure of a Computer System [6L]
Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Ques, Subroutines.
Module 2: Arithmetic for Computers [6L]
Processor organization, Information representation, number formats. Addition and Subtraction, Multiplication & division, Fixed point multiplication -Booth's algorithm, Fixed point division – Restoring and non-restoring algorithms
Module 3: Processor and Control Unit [9L]
ALU design, Floating Point arithmetic, IEEE 754 floating point formats, Subword Parallelism, Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. Microprogrammed Control - Basic concepts, minimizing microinstruction size, multiplier control unit. Microprogrammed computers – CPU control unit.

Module 4: Memory & I/O Systems [6L]
Memory organization, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory, System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces
Module 5: Parallelism [9L]
A Basic MIPS implementation, Building a Datapath, Control Implementation Scheme, Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network, Handling Data Hazards, and control Hazards — Exceptions. Parallel processing challenges — Flynn's classification — SISD, MIMD, SIMD, SPMD, and Vector Architectures.
Text/Reference Books :
1. V.CarlHammacher, "Computer Organisation", Fifth Edition.
2. A.S.Tanenbum, "Structured Computer Organisation", PHI, Third edition
3.Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs,N.J.,Prentice Hall Edition
4. M .M. Mano, "Computer System Architecture ",Edition
5. C.W. Gear, "Computer Organization and Programming", McGraw Hill, N.V. Edition
6. HayesJ.P, "Computer Architecture and Organization", PHI, Second edition

Subject Name: RF & Microwave Engineering
Subject Code: EC504C
Credit: 3
Total Contact: 36
Prerequisite: Learning of EM Theory &Antenna, Field theory, Analog Electronics
<u>Course Outcomes:</u>
Graduates of the ECE program will be able to:
CO1: Learn the Outline concepts of RF and Microwave engineering by determining the spectrum range, explain the working principle of planar transmission lines like Micro-strip lines, Coplanar waveguide, Slot line, coaxial line to understand the application of RF and Microwave frequency band in daily life.
CO2: Analyze the performance of microwave waveguide components using intrinsic wave impedance, phase and group velocity, power transmission, attenuation, waveguide excitation to develop an understanding of waveguide-based transmission lines.
CO3: Analyze the performance parameters of Microwave Passive components like Attenuators, Phase shifter, Directional coupler, Magic tee, hybrid ring, Circulators, Isolator, Microwave filter etc. by determining the equivalent voltages and currents, scattering parameters, transmission matrix etc. to develop the understanding and applications of those components in RF and Microwave circuits.
CO4: Define Microwave Semiconductor Devices like Gunn Diodes, Transit Time diodes, Schottky Barrier diodes, PIN diodes. Klystron up-to two cavities, Magnetron, TWT by describing the diagrams, operating principle to give a clear overview of tube devices and microwave solid state devices.
CO5: Understand the microwave measurements of active and passive components like wave guide, strip line, gunn diode etc. in microwave test bench using Frequency meter, Network analyzer, Power meter for analysing the performances of the active and passive components.
<u>Course Content:</u>
Module 1: Introduction[2L]
Introduction RF & Microwave Spectrum, Applications of Microwaves: Civil and Military,
Medical, EMI/EMC, Safety considerations.
Module 2: Transmission line[4L]
Coaxial line, Planar Transmission line- Micro-strip lines, Coplanar waveguide, Slot line-design consideration, field patterns, propagation characteristics, Comparison for different characteristics of the

above-mentioned lines.

Module 3: Microwave Waveguides[8L]

Mathematical model of microwave transmission in parallel plate waveguide, Concept of mode,Features of TEM, TE and TM Modes. Rectangular waveguide - TE10 mode analysis, cut-off frequency,propagation constant, intrinsic wave impedance, phase and group velocity, power transmission,attenuation, waveguide excitation, wall current. Concept of propagation constant, intrinsic wave impedance, phase and group velocity, power transmission, attenuation. Circular waveguide.

Module 4: Microwave Network Analysis of Passive Components [8L]

Realization of reactive elements as waveguide and planar circuit components. Equivalent voltages and currents, Network parameters for microwave circuits, Scattering Parameters, Waveguide Passive Components and their S-matrix Representation N-port networks-Properties of S matrix, Transmission matrix & their relationships; Microwave passive components and their S matrix representation: Attenuators, Phase shifter, Directional coupler, Bethe-hole coupler, Magic tee, hybrid ring, Circulators, Isolators; Microwave filter

Module 5: Microwave Active Devices [10L]

Microwave active components: Diodes, Transistors, Amplifiers, Oscillators, Mixers, Microwave Semiconductor Devices: Gunn Diodes, Transit Time diodes, Schottky Barrier diodes, PIN diodes.
Microwave Tubes: Klystron up-to two cavities, Magnetron, TWT.
Brief introduction to LNA

Module 6: Microwave Measurement [4L]

Typical Microwave Test Bench & measurement VSWR meter, Tunable detector, Slotted line and Probe detector, Frequency meter, Network analyzer, Measurement of VSWR – low, medium and high,
Measurement of power: low, medium and high, Frequency measurement.

Textbooks:

1. Samuel Y Liao, “Microwave Devices & Circuits”, Prentice HallofIndia,2006.
2. Susrut Das,“MicrowaveEngineering”,OxfordUniversityPress,2014.
3. Annapurna Das and Sisir Kumar Das, “Microwave Engineering”, Tata McGraw Hill Inc.,3rd Edn.2015.

Reference Books:

1. D. M. Pozar, “Microwave Engineering.”, John Wiley & sons, Inc., 2006.
2. R. E. Collins, Microwave Circuits, McGraw Hill
3. M .L. Sisodia, G. S. Raghuvanshi, “ Microwave Circuits and Passive Devices”, 2010

Co-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	1	-	1	-	-	1	-	2
CO2	3	3	3	2	1	1	-	-	-	-	2
CO3	3	2	2	2	-	1	-	-	2	-	2
CO4	3	2	1	1	-	1	-	-	-	1	2
CO5	3	3	3	2	1	1	1	-	2	-	2

Subject name: Power Electronics`
Code: EC504D
Credits: 3
Total contact hours: 36

Course Outcome:
Graduates of the ECE program will be able to:
CO1 – Learn how to analyse inverters and some basic applications.
CO2 – Analyse and design SMPS, controlled rectifiers DC to DC converters and DC to AC inverters.
CO3 – Learn and design DC to AC inverters, Charge controllers
CO4 – Analyse typical industrial application requirements and build a solution with commercially available electronic power devices.
Course Content:
Module 1: [7L] Characteristics of Semiconductor Power Devices:
Thyristor, power MOSFET and IGBT, Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode. Standard Driver Circuit Schematics for MoSFETs and IGBTs.
Module 2: [5L] Controlled Rectifiers:
Single phase: Study of semi and full bridge converters for R, RL, RLC and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.
Module 3: [5L] Choppers:
Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper
Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.
Module 4: [8L] Single-phase inverters:
Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for the above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter
Module 5: [6L] Switching Power Supplies:
Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.

Module 6: [5L] Application:
Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, and sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

Textbooks:
1) P.S. Bimbhra, Power Electronics, Khanna Book Publishing, 2022.

2) M Singh, K Khanchandani, "Power Electronics" McGraw Hill Education, 2nd Ed., 2017
3) Muhammad H. Rashid, "Power electronics" Prentice Hall of India.
4) P.C. Sen., "Modern Power Electronics", edition II, S.Chand& Co.
5) V.R.Moorthi, "Power Electronics", Oxford University Press.
6) Cyril W., Lander," Power Electronics", edition III,McGraw Hill.

References:

1) G K Dubey,S R Doradla: Thyristorised Power Controllers", New Age International Publishers.
2) Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.

CO-PO Mapping:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	1	-	-	-	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	1
CO3	3	2	3	2	2	-	-	-	-	-	1
CO4	3	3	3	3	3	1	-	-	1	1	2

Course Name: Object Oriented Programming using Java
Course Code: CS503
Contact: 3:0:0
Total Contact Hours:36
Credits: 3

Prerequisite: Partial Object-Oriented Programming using C++

Course Outcomes:

CS503.1: To define the process of interaction between Objects and System w.r.t. Object Oriented Paradigm.
CS503.2: To summarize basic concepts of Object Orientation in Java Programming along with different properties and features.
CS503.3: To implement various string handling functions as well as basic I/O operations in object-oriented environment.
CS503.4:Toexplainbasiccodereusabilityconceptw.r.t.Inheritance,PackageandInterface.
CS503.5:ToconstructJavaprogramsutilizingcoreobject-orientedconcepts,withafocuson Exception Handling, Multithreading, and Applet-based Web Programming.

Course Contents:

Module1:Introduction[2L]

Object Oriented Analysis (OOA) & Object-Oriented Design (OOD) - Concepts of object-oriented programming language, Relationships among objects and classes-Generalization, Specialization, Aggregation, Association, Composition, links, Meta-class, Object Oriented Programming concepts - Difference between Java and C++; Different features of Java.

Module2:JavaBasics[10L]

Basic concepts of java programming - Advantages of java, Byte-code & JVM, Data types, Different types of Variables, Java Operators & Control statements, Java loops, Array, Creation of class, object, method, Constructor- Definition, Usage of Constructor, Different types of Constructors, finalize method and garbage collection, Method & Constructor overloading, this keyword, useofobjects as parameter& methods returning objects, Call by value & call by reference, Static variables & methods, Nested & inner classes.

Module3:Basic Stringhandling &I/O[5L]

Basicstringhandlingconcepts-Conceptofmutableandimmutablestring,MethodsofString class, Methods of String buffer class, Command line arguments, basics of I/O operations – keyboard input using Buffered Reader, Scanner class in Java I/O operation.

Module4:InheritanceandJava Packages [8L]

Inheritance-Definition,Advantages,Differenttypesofinheritanceandtheirimplementation, Super and final keywords, super() method, Method overriding, Dynamic method dispatch, Abstract classes & methods, Interface -Definition,Use of Interface, Multiple inheritance by using Interface, Java Packages - Definition, Creation of packages, Java Access Modifiers - public, private, default and protected, Importing packages, member access for packages.

Module 5: Exception handling, Multithreading and Applet Programming [11L]
Exception handling-Basics, different types of exception classes.Difference between Checked & Unchecked Exception, Try & catch related case studies, Throw, throws & finally, Creation of user defined exception, Multithreading - Basics, main thread, Thread life cycle, Creation of multiple threads -yield(), suspend(), sleep(n), resume(), wait(), notify(), join(), is Alive(),Thread priorities,threadsynchronization,Interthreadcommunication,deadlocksfor threads, Applet Programming - Basics, applet life cycle, difference between application & applet programming, Parameter passing in applets.

Textbooks:

1. HerbertSchildt –“Java:TheComplete Reference”– 9^{th}Ed.– TMH
2. E.Balagurusamy–“Programming withJava:APrimer”–3rdEd.– TMH.

ReferenceBooks:

1. R.K.Das–“CoreJavaforBeginners”–VIKAS PUBLISHING.
2. Rambaugh,JamesMichael,Blaha –“ObjectOrientedModellingandDesign”–Prentice Hall, India.

CO-POMapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CS503.1	3	3	2	3	3	-	-	-	-	-	3
CS503.2	2	3	3	2	2	-	-	-	-	-	2
CS503.3	3	3	2	2	1	-	-	-	-	-	1
CS503.4	2	2	3	2	3	-	-	-	-	-	2
CS503.5	3	3	2	3	1	-	-	-	-	-	1

Subject: Introduction to Quantum Computing
Code: CS(EC) 501B
Credit: 3
Contact: 36

Prerequisites: Quantum Mechanics, Linear Algebra, Complex Numbers and Probability, Computer Science, Basic Physics, Programming

Objectives:

This course covers foundational quantum computing concepts, delving into quantum circuits, information theory comparisons, and quantum algorithms like Shor's factorization and Grover's search. It explores quantum information processing theories, error correction methods, and their implications in classical computation, emphasizing both mathematical and physical underpinnings.

Course outcomes:

After completion of the course, students will be able to

CO1: Apply knowledge of foundational quantum mechanics principles to analyze and interpret quantum circuits and gate operations.

CO2: Demonstrate proficiency in constructing and optimizing quantum circuits for specific computational tasks.

CO-3: Evaluate and compare different quantum algorithms, including their computational advantages over classical counterparts.

CO-4: Design and implement strategies for quantum state manipulation and engineering, incorporating entanglement principles.

CO-5: Analyze real-world problems to determine their suitability for quantum computing solutions, considering challenges and limitations in implementation.

CO-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	-	-	-	-	-	-	-
CO2	2	3	3	3	3	-	-	-	-	-	1
CO3	1	2	3	3	3	2		1	2	-	-
CO4	2	3	3	-	3	-	-	-	-	-	-
CO5	2	3	3	2	3	3	-	-	-	-	2

Course Content:

Module 1: Foundations of Quantum Mechanics (11 lectures)

Historical context and key experiments leading to quantum theory, Quantum postulates: superposition, measurement, and uncertainty principles, Introduction to Dirac notation and basic quantum state representation, Quantum gates: single-qubit gates (e.g., Pauli gates, Hadamard gate) and multi-qubit gates (e.g., CNOT gate), Quantum circuit model: construction and representation using gate operations, Universal gate sets and their significance in quantum computation, Qubit properties: understanding the physical systems used as qubits (e.g., spin, superconducting circuits, trapped ions), Qubit operations: manipulation of quantum states, state preparation, and measurement, Qubit coherence and quantum error sources, Building quantum circuits: examples and applications of constructing circuits for specific tasks (e.g., teleportation, superdense coding). Universal quantum gates and their role in quantum algorithms, Circuit optimization techniques and quantum circuit depth considerations.

Module 2: Qubits and Quantum States (9 lectures)

Qubit states: Bloch sphere representation and visualization of qubit states, Mathematical formalism: density matrices, pure and mixed states, Entropy and quantum information measures, Quantum state transformations: unitary evolution and quantum gates, Quantum state tomography and methods for state reconstruction, Quantum state engineering and control techniques, Entanglement basics: understanding entangled states and their properties, Entanglement measures and quantification, Applications of entanglement in quantum communication and computation, Overview of fundamental quantum algorithms (e.g., Deutsch's algorithm, Grover's search algorithm), Quantum parallelism: understanding how quantum algorithms achieve computational speedup, Comparison of quantum algorithms to classical counterparts.

Module 3: Quantum Algorithms and Applications (8 lectures)

Detailed walkthrough of Shor's algorithm for integer factorization, Quantum Fourier Transform: understanding its role in quantum algorithms, Prime factorization and its relevance in cryptography, Quantum simulation: applications in modeling quantum systems (e.g., chemistry, materials science), Quantum optimization algorithms (e.g., adiabatic quantum computing, variational algorithms), Comparative advantages of quantum optimization over classical methods, Practical applications of quantum computing in diverse fields (e.g., finance, healthcare, cryptography), Industry use-cases and ongoing research in utilizing quantum computation, Challenges and limitations in implementing quantum solutions for real- world problems.

Module 4: Quantum Error Correction and Quantum Cryptography (4 lectures)

Quantum error models and sources of quantum errors, Quantum error correction codes (e.g., Shor code, surface code) and their properties, Quantum error correction techniques and fault-tolerant quantum computation, Foundations of quantum key distribution (QKD) and its principles.

Module 5: Quantum Hardware and Future Directions (4 lectures)

Overview of current quantum computing architectures (superconducting qubits, trapped ions, photonic qubits, etc.), Hardware challenges and advancements in building quantum computers, Comparative analysis of different quantum computing platforms, Quantum error rates and decoherence: challenges in scaling up quantum systems, Quantum hardware improvements (e.g., error correction, qubit connectivity), Quantum software and hardware co-design principles.

Books:

1. "Quantum Computation and Quantum Information" by Michael Nielsen and Isaac Chuang
2. "Quantum Computing: A Gentle Introduction" by Eleanor G. Rieffel and Wolfgang H. Polak
3. "Quantum Computing for Computer Scientists" by Noson S. Yanofsky and Mirco A. Mannucci
4. "Programming Quantum Computers: Essential Algorithms and Code Samples" by Eric R. Johnston, Nic Harrigan, and Mercedes Gimeno-Segovia
5. "Quantum Computing: A Very Short Introduction" by John Preskill

Subject name: Cloud Computing
Subject code: CS(EC)501C
Credit: 3
Total contact: 35

Prerequisite: • Basic Computer Science Knowledge • Networking Fundamentals • Operating Systems Understanding • Familiarity with Web Technologies

Course objective: This course provides an in-depth understanding of cloud computing essentials, covering infrastructure, security, application development, resource optimisation, and emerging trends. Students gain hands-on skills through practical labs to effectively manage and deploy cloud systems.

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

CO1: Apply the fundamental cloud computing concepts, models, architectures, and their evolution in modern computing systems.

CO2: Apply theoretical knowledge to design, deploy, and manage cloud-based systems, integrating security measures and best practices in diverse technological environments.

CO3: Analyze various cloud architectures, security frameworks, and application development strategies, identifying potential vulnerabilities and proposing effective solutions.

CO4: Develop problem-solving skills to address complex challenges in cloud computing, including resource optimization, compliance issues, and emerging technology integration.

CO5: Foster a commitment to continuous learning, staying updated with emerging trends, ethical considerations, and future advancements in cloud technology.

CO-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	-	-	-	-	-	-	-
CO2	2	3	3	3	3	-	-	-	-	-	1
CO3	1	2	3	3	3	2		1	2		
CO4	2	3	3	-	3	-	-	-	-	-	-
CO5	2	3	3	2	3	3	-	-	-	-	2

Module 1: Fundamentals of Cloud Computing (Total Lectures: 7)
Introduction to Cloud Computing: Concepts and Definitions, Historical Evolution and Milestones in Cloud Technology, Cloud Service Models: IaaS, PaaS, SaaS, Cloud Deployment Models: Public, Private, Hybrid, Advantages and Challenges of Cloud Computing, Case Studies: Real-world Applications of Cloud Technology, Future Trends and Innovations in Cloud Computing

Module 2: Cloud Architecture and Infrastructure (Total Lectures: 8)
Cloud Infrastructure Components and Components Overview, Network Design and Protocols in Cloud Environments, Storage Technologies: Databases, File Systems, Scalability and Elasticity in Cloud Systems, Virtualization Techniques in Cloud Computing, Hands-on Lab: Setting up Virtual Machines
Module 3: Security and Compliance in Cloud Computing (Total Lectures: 6)
Security Challenges in the Cloud: Threats and Vulnerabilities, Identity and Access Management (IAM) in Cloud Environments, Data Protection Strategies and Encryption in the Cloud, Compliance Frameworks and Governance in Cloud, Risk Management Strategies for Cloud Environments, Security Best Practices and Case Studies
Module 4: Cloud Services and Application Development (Total Lectures: 8)
Cloud-native Development: Principles and Practices, Containers and Orchestration: Docker, Kubernetes, Microservices Architecture and Implementation, DevOps Methodologies in Cloud-based Projects, Serverless Computing: Concepts and Use Cases, Hands-on Lab: Implementing Containerization andOrchestration, Hands-on Lab: Deploying Microservices in Cloud Environments, Case Studies on Cloud Application Development
Module 5: Cloud Management and Optimization (Total Lectures: 6)
Cloud Service Management and Service Level Agreements, Performance Monitoring and Optimization Techniques, Cost Management and Billing in Cloud Environments, Automation and Orchestration Tools, SLAs, Metrics, and Governance for Cloud Services, Emerging Trends in Cloud Management and Optimization, AWS – Basic working principle. and Containers, High Availability and Disaster Recovery in Cloud Architectures, Case Studies on Cloud Architecture Implementations

Paper Name: Operating System
Paper Code: CS(EC)501D
Contact Hours/Week: 3
Credit: 3 Total
Contact Hours: 36L
Prerequisites:
1. Computer organization
2. Computer Architecture
3. Data Structures
4. Algorithms & Programming Concept

Course Outcomes (COs):
After attending the course students should be able to

CO1	Understand the fundamental concepts of Operating System, Protection & Security and differentiate different types of Operating System.
CO2	Understand and implement process & thread; understand, apply, compare different process synchronization algorithm and inter process communication to solve engineering problems
CO3	Understand/explain/analyze different synchronization techniques, critical section problems and deadlock and apply them to solve engineering problems.
CO4	Understand/explain different memory management techniques including virtual memory management; also able to apply, compare, and implement different page replacement algorithms to solve engineering problems.
CO5	Understand/explain different I/O mechanisms, File structures and disk management techniques and solving engineering problems applying different disk scheduling algorithms.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3							
CO2	3	3	3	3							
CO3	3	3	3	3							
CO4	3	3	3	3							
CO5	3	3	3	3							

Module – 1:[3L]
Functionalities of Operating System, Evolution of Operating System. Types of Operating System: batch, multi-programmed, time-sharing, real-time, distributed, parallel, Structural overview, Protection & Security.[3L]
Module – 2: [9L]
Processes: Concept of processes, process states, PCB, process scheduling, co-operating processes, independent process, suspended process, Interaction between processes and OS, [2L] Threads: overview, benefits of threads, user and kernel level threads. [1L] CPU scheduling: Scheduling criteria, preemptive &non-preemptive scheduling, scheduling algorithms (FCFS, SJF, SRTF, RR, priority, multilevel queue, multilevel feedback queue scheduling). [6L]
Module – 3: [10L]
Process Synchronization: background, critical section problem, synchronization hardware, classical problems of synchronization (producer-consumer, readers-writer, dining philosophers, etc), semaphores.[5L] Deadlocks: deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.[5L]
Module 4: [6L] Background, logical vs. physical address space, swapping, contiguous memory allocation, paging, Segmentation, TLB. [3L] Virtual Memory: background, demand paging, page replacement algorithms (FCFS, LRU, Optimal), thrashing, Working set model. [3L]
Module 5: [8L] Disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK etc), disk reliability, disk formatting, boot block, bad blocks. [2L] File: File concept, access methods, directory structure, file system structure, UNIX file structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector). [2L] I/O: I/O hardware, polling, interrupts, DMA, caching, buffering, blocking-non blocking I/O. [1L] Case Study: Inter-process communication: Message passing. Thread models, monitors [3L]

Text Book:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts.
2. Operating systems: concepts and design by Milan Milenkovič- Mc. Graw-Hill Publication

Reference Book:

1. Dietel H. N., —An Introduction to Operating Systems‖, Addison Wesley.
2. Andrew Tanenbaum, Modern Operating Systems, Prentice Hall.
3. William Stallings, Operating Systems, Prentice Hall.

Subject Name: Advanced Microprocessor & Microcontroller Lab
Subject code: EC592
Contact: 0:0:3
Credit: 1.5

Prerequisites: Knowledge in Digital Electronics
Course Outcome:
Graduates of the ECE program will be able to:
CO1: Able to understand small assignments using the 8085 basic instruction sets and memory mapping through trainer kit and simulator.
CO2: Able to write 8085 assembly language programs like Addition, Subtraction, Multiplication, Square, Complement, look up table, copying a block of memory, Shifting, Packing and unpacking of BCD numbers, Ascending order, Descending order etc. using trainer kit.
CO3: Able to analyze the interfacing technique using 8255 trainer kits through subroutine calls and IN/OUT instructions like glowing LEDs accordingly, stepper motor rotation etc.
CO4: Able to evaluate fundamental of 8051 programs using the trainer kit.
List of Experiments:
1.Familiarization with 8085 register level architecture, the basic instruction sets (data transfer, arithmetic, logical, branching) and the trainer kit components including the memory map.
2.Familiarization with the process of storing, executing, and viewing the contents of memory as well as registers in the trainer kit 8085 and simulator through small assignments.
3.Programming using 8085 kit and simulator for: Addition, Subtraction, Multiplication by repeated addition method, Square, Complement, look up table, Copying a block of memory, Shifting, Packing and unpacking of BCD numbers, Addition of BCD numbers, Binary to ASCII conversion, smallest and largest number from an array of numbers, Ascending order, Descending Order, String Matching, Multiplication using shift and add method.
4.Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly, glowing of seven segment display.
5.Program for serial communication between two trainer kits.
6.Interfacing of 8255: Keyboard, Stepper motor rotation.
7.Study of 8051 Micro controller kit and writing programs.
Textbooks:
1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar, Penram International
2. The 8051 microcontroller - K. Ayala, Thomson
3. Microprocessors & interfacing – D. V. Hall, Tata McGraw-hill
4. Ray &Bhurchandi, Advanced Microprocessors & Peripherals, TMH R21
5. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley, Pearson
6. An Introduction to Microprocessor and Applications –Krishna Kant,Macmillan

Reference Books:
1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxford university press
2. 8086 Microprocessor –K Ayala, Cengage learning
3. The 8051 microcontrollers – Uma Rao and AndhePallavi, Pearson

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	1	2	-	-	2	2	2	3
CO2	2	3	3	1	2	-	-	2	2	2	2
CO3	3	3	3	1	2	-	-	2	2	2	3
CO4	3	3	3	2	2		1	2	2	2	2

Course Name: Control Systems Lab
Course Code: EC 593
Contacts: 0:0:3
Credit: 1.5

Course Objectives:
To introduce concepts of mathematical modeling, open loop and feedback control systems.
To employ time domain analysis to predict and diagnose transient performance parameters of different types of systems for standard input signals.
To understand the various techniques of stability analysis in the time and frequency domain.
To identify the needs of different types of controllers and compensators to meet the required dynamic response from the system.

Course Outcomes: After completing the following experiments, students will be able to
CO1: Understand mathematical models of physical systems and study their nature, configuration and relevant mapping into equivalent models.
CO2: Determine transient and steady-state behaviour of different systems using standard test signals.
CO3: Analyze and solve the importance of gain, location of poles and zeros to design a system.
CO4: Evaluate the relative stability of control systems using frequency domain analysis.
CO5: Design controllers according to desired performance specifications.

CO-PO mapping:
Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	-	-	-	-	1	1	1
CO2	3	2	2	2	1	-	-	-	2	1	1
CO3	3	2	2	2	1	-	-	-	2	1	1
CO4	3	2	2	2	1	-	-	-	2	1	1
CO5	2	2	3	2	1	1	1	-	2	1	1

List of Experiments:
1. Familiarization with MATLAB Control System Toolbox and SIMULINK.
2. Study of the effect of feedback on systems.
3. Study of first-order systems having different time constants.

4. Study of second order systems having different damping ratios.
5. Study of time response of different electrical and mechanical system.
6. Verification and validation of time domain specifications of second order systems.
7. Study of steady-state errors for different 'types' of systems.
8. Study of system stability using Root locus technique.
9. Determination of Bode-plot and computation of gain crossover frequency, phase cross over frequency, gain margin and phase margin using MATLAB.
10. Study of closed loop stability using Nyquist plot.
11. Study of system representation using State Model.
12. Determination of PI, PD and PID controller action on first-order simulated process.
13. Evaluation of steady-state error, setting time, percentage peak overshoots, gain margin and phase margin with addition of lead compensator/lag compensator in forward path transferfunction using MATLAB.
14. Tuning of PID Controller.

Course Name: Mobile Communication and Network Lab

Course Code:EC594A

Credits:1.5

Course Outcomes (COs)

Graduates of the ECE program will be able to:

CO1:Understandpathlossandthefactorsinfluencing it.

CO2:Analyzethe3dBbandwidthofabasestationantenna.

CO3:Applytheconceptofco-channelinterferenceandevaluateSignal-to-Interference-and-NoiseRatio (SINR).

CO4:Analyzetheimpactofparameterssuchascellradius,basestation(BS)transmitpower,and frequency reuse,sectoring,shadowingeffect,BSheight,pathlossexponent,andverticalbeamtilton downlink C/I ratio.

CO5:Understandandanalyzetheeffectofhandoverthresholdandmarginon SINR,calldrop probability, handover probability, and characterize radio attenuation.

List of Experiments

1. Computereceivedsignalstrengthasafunctionofdistance,antennaheight,andcarrierfrequency.
2. Studytheeffectoftransmitterpower,pathlossexponent,carrierfrequency,andantennaheights (transmitter and receiver) on signal strength.
3. Calculatepathlossexponentandshadowfadingvariancefrommeasurementstodetermine large-scale propagation characteristics.
4. Determinethe3dBbandwidthofabasestationantenna.
5. CalculateandplotSINRvs.distanceatthemobilestation(MS)byvaryingshadowingeffect, vertical beam pattern, and tilt angle.
6. CalculateandplotSINRvs.distanceatthemobilestation(MS)byvaryingtheshadowingeff

ect, vertical beam pattern, and tilt angle.
7. Identifyco-channelcellsforaspecificcellandlocatecellclusterswithinageographicareato understand frequency reuse.
8. StudytheeffectofhandoverthresholdandmarginonSINR,calldropprobability,andhand over probability.
9. Characterize radio attenuation using the Okumura propagation model.
10. Characterize radio attenuation using the Hata propagation model.

Textbooks

1. TheodoreS.Rappaport,*Wireless Communications: Principles and Practice*, PHI/Pearson Education.
2. J.Schiller, *Mobile Communications*, Addison-Wesley.
3. WilliamC.Y.Lee,*Mobile Cellular Telecommunication: Analog and Digital Systems*, 2ndEdition, McGraw Hill.

Reference Books

1. Wang, *Wireless Communication Systems*, Pearson Education.
2. Talukdar, *Mobile Computing*, TMH.
3. J.W.Mark and W.Zhuang,*Wireless Communication and Networking*, PHI.
4. Santamariaetal.,*Wireless LAN Systems*, Artech House.
5. Stallings, *Wireless Communication & Networks*, Pearson Education.

CO-PO Mapping

CO	PO1	PO	PO	PO	PO	PO6	PO7	PO8	PO9	PO10	POll
CO1	3	2	-	1	2	-	-	-	-	-	1
CO2	3	3	2	2	2	-	-	-	-	-	1
CO3	3	3	2	2	3	-	-	-	-	-	1
CO4	3	3	3	3	3	-	-	-	-	-	1
CO5	3	3	2	3	3		-	-	-	-	2

Course Name: Computer Architecture Lab
Course Code: EC594B
Contacts: 0:0:3
Course Outcomes:
After the completion of the course, students will be able to
CO1: Learn VHDL programming
CO2: Implement arithmetic circuits using VHDL programming
CO3: Implement RAM and ROM architectures
CO4: Design register, counter and control unit
CO5: Implement complex projects related to computer architecture

List of Experiments:

1. Introduction to HDL programming (includes different modelling styles and programming structure)
2. Programming of basic gates(AND, OR, NAND, NOR, XOR, XNOR) with HDL
3. Design of half adder, half-subtractor, full adder and full-subtractor
4. 8-bit Adder (Parallel Adder), Subtraction (Parallel Subtractor/ 1's complement/ 2'scomplement technique)
5. Multiplication (Array based design/ Radix-2 Booth's algorithm/ Karatsuba technique), Division (Restoring/ Non-Restoring algorithm)
6. Design of flipflops (D, Tand JK)
7. 8-bit Register design (with left and right shift feature)
8. 8-bit RAM design with opcode fetching and data fetching
9. 8-bit simple ALU design
10. 8-bitsimple CPU design

Text/ Reference Books:

1. V.CarlHammacher, "Computer Organisation", Fifth Edition.
2. A.S.Tanenbum, "Structured Computer Organisation", PHI, Third edition
3. Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs, N.J., PrenticeHall Edition
4. M.M.Mano, "Computer System Architecture", Edition
5. C.W.Gear, "Computer Organization and Programming", McGraw Hill, N.V. Edition
6. 6. Hayes J.P, "Computer Architecture and Organization", PHI, Second edition

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	1	-	-	3	-	2	-	1	-	3
CO2	-	3	-	2	-	1	-	-	2	-	2	3
CO3	3	-	-	-	1	-	3	1	-	1	-	3
CO4	2	-	1	-	3	-	2	-	2	-	2	3
CO5	3	-	1	-	-	3	2	-	-	-	-	3

Subject Name: RF & Microwave Engineering Lab
Subject Code: EC594C
Credits: 1.5
Course Outcome:
Graduates of the ECE program will be able to:
CO1: Analyse, identify and list out special type transmission lines, its characteristics in microwave
frequencies and concept of load.
CO2: Apply engineering mathematics to recognize, learn, categorize, arrange and implement suitably
the various microwave passive devices.
CO3: Analyse and use the various sources of microwave energy and the characters of its operation.
CO4: Design, compute, solve and demonstrate microwave components properly using various hardware, software tools and measuring instruments in the field of Radio Frequencies, for the betterment of communication engineering, medical science and various domestic and commercial engineering.

List of Experiments:

1. Familiarization to microwave passive and active components and microwave test bench
2. Measurement of microwave frequency/wave length /guided wave length in wave guide test bench using frequency /wave meter
3. Determination of phase and group velocities in a waveguide carrying TE10 Wave from Dispersion diagram [ω−βPlot].
4. Measurement of unknown impedance using shift in minima technique using a waveguide test bench/Measurement of the susceptance of an inductive and or a capacitive window using shift in minima technique using a waveguide test bench
5. Study of the characteristics of a Reflex Klystron oscillator.
6. Study of Gunn-oscillator Characteristics using X-band waveguide test bench.
7. Measurement of coupling factor, Directivity, Insertion loss and Isolation of a Directional coupler using X-band waveguide test bench setup.
8. Scattering matrix of a magic tee/E-plane tee/H-plane tee using waveguide test bench at X-band.
9. Familiarization of spectrum analyser with tracking generator
10. Experimental/Simulation Study of filter (LPF, HPF, BPF) response.

Reference Books:

1. ML Sisodia& GS Raghuvanshi, Basic Microwave Techniques and Laboratory Manual; Wiley Eastern Limited1987
2. EL Ginzton, Microwave Measurements, McGraw-Hill Book Co.
3. M Sucher, J Fox, Moe Wind, Handbook of Microwave Measurements, Vol I, WileyInterscienceInc

CO- PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	2	2	-	3	1	2
CO2	3	3	3	3	2	2	2	-	3	1	2
CO3	3	3	3	3	2	2	2	-	3	-	2
CO4	3	3	3	3	2	2	2	-	3	1	2

Subject name: Power Electronics Lab
Code: EC594D
Credits: 1.5
Total contact hours: 36

Course Outcomes:

- **CO-1:** Understanding Power Electronic Devices: Identifying and analyzing the characteristics of different switching devices.
- **CO-2:** Converter Operation: Understanding the principles and operation of various power converter topologies (rectifiers, choppers, inverters, etc.).
- **CO-3:** Circuit Design and Analysis: Designing and simulating power electronics circuits to meet specific requirements.
- **CO-4:** Practical Skills: Gaining hands-on experience with lab equipment, circuit construction, and measurement techniques as well as simulation technique.

Suggested List of Experiments:

1. Characteristics of SCR and TRIAC.
2. Characteristics of MOSFET and IGBT.
3. AC to DC half-controlled converter.
4. AC to DC fully controlled converter.
5. Step down and step up MOSFET based choppers.
6. IGBT based single phase PWM inverter.
7. IGBT based three phase PWM inverter.
8. AC Voltage controller.
9. Switched mode power converter
10. Simulation of PE circuits (1Φ & 3Φ semi converter, 1Φ & 3Φ full converter, dc-dc converters, ac voltage controllers).

Textbooks:

1) P.S. Bimbhra, Power Electronics, Khanna Book Publishing, 2022.
2) M Singh, K Khanchandani, “Power Electronics” McGraw Hill Education, 2nd Ed., 2017
3) Muhammad H. Rashid, “Power electronics” Prentice Hall of India.
4) P.C. Sen., “Modern Power Electronics”, edition II, S.Chand& Co.

5) V.R.Moorthi, "Power Electronics", Oxford University Press.
6) Cyril W., Lander," Power Electronics", edition III,McGraw Hill.

CO PO MAPPING

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	2	-	-	-	-	-	1
CO2	3	3	2	2	2	-	-	-	-	-	1
CO3	3	2	3	2	3	-	-	-	1	1	1
CO4	1	2	2	3	3	-	-	-	2	1	1

Course Name: Object Oriented Programming using Java Lab
Course Code: CS593
Contact: 0:0:3
Total Contact Hours:36
Credits: 1.5

Prerequisites:

1. Computer Fundamentals
2. Basic understanding of Computer Programming and related Programming Paradigms
3. Problem Solving Techniques with proper logic Implementation.

Course Objective(s):

- It demonstrates that how can you change the implementation of an object without affectinganyothercodebyincreasingdatasecurityandprotectingunwanteddataaccess. (Encapsulation).
- Itallowsyoutohavemanydifferentfunctions,allwiththesamename,alldoingthesame job, but depending upon different data. (Polymorphism).
- It guides you to write generic code: which will work with a range of data, so you don't have to write basic stuff over, and over again. (Generics).
- It lets you write a set of functions, then expand them in different direction without changing or copying them in any way. (Inheritance)

Course Outcomes:

On completion of the course students will be able

CS593.1:TodescribetheobjectorientedapproachinJavabyoutliningtherelationship between classes, objects, and constructors.
CS593.2:ToapplytheconceptofcodereusabilityinJavathroughtheuseofinheritanceand class hierarchies.
CS593.3:ToimplementJavaprogramsusingencapsulation,polymorphism,andrelevant object-oriented keywords.
CS593.4:Toanalyzeobject-orientedfeaturessuchasdataabstraction,packages,andinterfaces to determine their roles in Java programming.

CS593.5:ToconstructJavaapplicationsusingexceptionhandling,multithreading,and applet-based web programming techniques.

Course Contents:

Week–1:

Basic Java programs such as

i. Printing "Hello, GNIT".
ii. Checking whether a number is even oro dd.
iii. Finding out the roots of a quadratic equation.
iv. Finding out the factorial of a given number.
v. Printing Fibonacci series upto n terms.
vi. Creating a class calculator that has 4 methods like add, sub, mul& div. Then doing the addition, subtraction, multiplication, and division of 2 integer numbers using these 4 methods.

Week–2:

Java programs to implement default constructor, parameterized constructor using command line argument, 'this' keyword.

Week–3:

Javaprogramstoimplementmethodoverloading,constructoroverloading,callbyvalue,call by reference, recursion.

Week–4:

Javaprogramstoimplementthedifferencebetweenpublicandprivateaccessspecifier, 'static' keyword, inner class.

Week–5:

Javaprogramstoimplementsimpleinheritance,hierarchicalinheritance,andmultilevel inheritance.

Week–6:

Javaprogramstoimplement'super'keywordtoaccessasuperclassmember,'super'keyword to access a super class constructor, method overriding.

Week–7:

Java programs to implement run-time polymorphism, abstract class and method.

Week–8:

Java programs to implement interface, multiple inheritance.

Week–9:

Java programs to

i. Create two user-defined packages pkg1 and pkg2 and import both to another program which is outside the packages.

ii. Create multiple packages containing classes with identical names.

iii. Show how a protected variable of one package can be accessed in a subclass in an other package.

iv. Show how to add multiple public classes to a single package.

Week–10:

Java programs to implement Arithmetic Exception, Array Index Out Of Bounds Exception, ‘throw’ and ‘throws’ keywords, finally block.

Week–11:

Java programs to

i. Create 3 threads –the 1st thread to display GOOD MORNING for every1 second, the 2nd thread to display HELLO for every 2 seconds and the 3rd thread to display WELCOME for every 3 seconds.

ii. implement the above program by assigning priorities to the created threads such that the 1st thread executes first followed by the 2nd thread and lastly the 3rd thread.

Week–12:

Java programs to

i. develop an applet that display simple message.

ii. Develop an applet that will add two integer numbers.

iii. Develop an applet that will draw lines, rectangle and oval.

Text books:

1. Herbert Schildt– "Java: The Complete Reference"–9thEd.– TMH
2. E.Balagurusamy –"Programming with Java:A Primer" –3rd Ed.– TMH.

Reference Books:

1. R.K.Das– "Core Java for Beginners" –VIKAS PUBLISHING.
2. Rambaugh, James Michael, Blaha–"Object Oriented Modelling and Design"–Prentice Hall, India

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CS593.1	2	2	3	3	2	-	-	-	-	-	3
CS593.2	1	3	2	2	3	-	-	-	-	-	1
CS593.3	2	-	1	2	2	-	-	-	-	-	2
CS593.4	3	2	3	2	3	-	-	-	-	-	2
CS593.5	2	3	1	3	2	-	-	-	-	-	1

Subject: Introduction to Quantum Computing LabCode:
CS(EC) 591B
Credit: 1.5

Objectives:

The course aims to impart foundational knowledge in quantum mechanics for constructing and manipulating quantum circuits, implementing algorithms, and simulating error correction. Students will visualize qubit states, explore practical quantum applications, and critically analyze challenges in implementing quantum solutions for real-world problems.

Course outcomes:

CO-1. Analyze quantum principles and construct circuits applying single/multi-qubit gates.

CO-2. Design and implement fundamental quantum algorithms, assessing their computational superiority.CO-3.

Explain error correction, evaluate error models, and simulate error correction codes.

CO-4. Visualize qubit states through Bloch sphere representation and perform quantum state reconstruction.

CO-5. Assess real-world quantum computing applications, discussing implementation challenges and limitations.

CO-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	-	-	-	-	-	-	-
CO2	2	3	3	3	3	-	-	-	-	-	-
CO3	1	2	3	3	3	2	-	-	-	-	-
CO4	2	3	3	-	3	-	-	-	-	-	-
CO5	2	3	3	2	3	3	-	-	-	-	-

To conduct the experiments software frameworks like Qiskit, Cirq or equivalent are suggested.

Experiment 1: Quantum Circuit Construction and Simulation

Construct and simulate basic quantum circuits using single-qubit and multi-qubit gates.
Experiment 2: Qubit State Visualization on Bloch Sphere

Visualize and explore qubit states using the Bloch sphere representation.

Experiment 3: Quantum Error Simulation and Correction

Simulate quantum errors and implement basic error correction codes (e.g., bit-flip code) to mitigate errors in a

quantum circuit.
Experiment 4: Entanglement Generation and Measurement

Generate entangled states and perform measurements to confirm entanglement using Bell state analysis.
Experiment 5: Quantum State Tomography

Reconstruct unknown quantum states using quantum state tomography techniques.
Experiment 6: Implementing Quantum Algorithms

Implement fundamental quantum algorithms (e.g., Deutsch's algorithm, Grover's search) using a quantumprogramming framework (Qiskit, Cirq).

Experiment 7: Quantum Fourier Transform and Applications

Implement the Quantum Fourier Transform and apply it in simulating period finding for a simple function.

Experiment 8: Quantum Key Distribution Simulation

Simulate the BB84 quantum key distribution protocol and analyze the security properties of the exchangedkey.

Experiment 9: Quantum Circuit Optimization

Explore techniques for optimizing quantum circuits (e.g., reducing gate count, minimizing circuit depth) for specific quantum algorithms.

Experiment 10: Quantum Hardware Analysis

Analyze the characteristics and limitations of different quantum computing architectures (e.g.,superconducting qubits, trapped ions) through simulation or analysis of real experimental data.

Subject name: Cloud Computing Lab
Subject code: CS(EC)591C
Credit: 3

Objective: These lab experiments provide hands-on experience in different aspects of cloud computing, allowing students to apply theoretical knowledge to practical scenarios and gain proficiency in cloud-based technologies. Adjustments can be made based on available resources and specific learning objectives of the course.

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

CO1: Demonstrate a comprehensive understanding of cloud computing fundamentals, including service models, deployment models, and underlying infrastructure.

CO2: Apply theoretical knowledge to effectively utilize cloud platforms, implementing and managing cloud based solutions in diverse contexts.

CO3: Evaluate and implement robust security measures, including access control, encryption, and compliance, to ensure data protection in cloud environments.

CO4: Design and implement scalable and optimized cloud architectures, employing resource management and performance optimization techniques.

CO5: Analyze emerging trends and innovations in cloud computing, demonstrating an understanding of their impact on future technological landscapes.

CO-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	-	-	-	-	-	-	-
CO2	2	3	3	3	3	-	-	-	-	-	-
CO3	1	2	3	3	3	2	-	-	-	-	-
CO4	2	3	3	-	3	-	-	-	-	-	-
CO5	2	3	3	2	3	3	-	-	-	-	-

Experiments:

1. Setting Up a Virtualized Environment: Students create and manage virtual machines using a hypervisorlike VirtualBox or VMware, understanding the basics of virtualization.
2. Networking in a Cloud Environment: Design and configure virtual networks, subnets, and securitygroups using cloud platforms like AWS or Azure.
3. Implementing Data Backup and Recovery: Set up and test backup solutions on cloud storage services, demonstrating data recovery processes in case of failure.
4. Security Measures Implementation: Configure access control lists (ACLs), encryption, and multifactor authentication in a cloud environment to enhance security.
5. Containerization with Docker: Build, deploy, and manage containers using Docker, understanding the principles of containerization.
6. Microservices Deployment: Develop and deploy a simple application using a microservices architectureon a cloud platform.
7. CI/CD Pipeline Setup: Create a continuous integration/continuous deployment (CI/CD) pipeline usingtools like Jenkins or GitLab CI.
8. Serverless Computing Experiment: Explore serverless architecture by deploying functions in a serverless environment (e.g., AWS Lambda or Azure Functions).
9. Performance Monitoring and Optimization: Utilize monitoring tools to analyze and optimize cloud resource usage for a given application.
10. Cost Management and Billing Simulation: Simulate a cloud environment with various services to understand cost estimation, billing models, and cost optimization techniques.

Course Name: Operating Systems Lab
Course Code: CS(EC)591D
Allotted Hours: 36L

Prerequisites: Students must have the knowledges of
1. Computer organization
2. Computer Architecture
3. Data Structures
4. Algorithms & Programming Concept

Course Outcomes (COs): After attending the course students should be able to

CO1	Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF,and Priority.
CO2	Understand the concepts of deadlock in operating systems.
CO3	Implement them in Multiprogramming system.
CO4	Create process creation and implement inter process communication
CO5	Analyze the performance of the various page replacement schemes

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3				3		
CO2	3	3	3	3	3				3		
CO3	3	3	3	3	3				3		
CO4	3	3	3	3	3				3		
CO5	3	3	3	3	3				3		

Course Content:

1. Essential Linux Commands[9P]: Commands for files and directories cd, cp, mv, rm, mkdir, more, less, creating and viewing files, using cat, file comparisons, View files, kill, ps, who, sleep, grep, fgrep, find, sort, cal, banner, touch, file related commands – ws, sat, cut, grep etc. Mathematical commands –expr, factor, units, Pipes (use functions pipe, popen, pclose), named Pipes (FIFOs, accessing FIFO)

2. Shell Programming [6P]: Creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, and commands).

3. Process [3P]: Starting new process, replacing a process image, duplicating a processimage.

4. Semaphore [3P]: Programming with semaphores (use functions semget, semop, semaphore_p, semaphore_v).

5. POSIX Threads[6P]: Programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel).

6. Shared Memory [9P]: Create the shared memory, Attach the shared memory segment to theaddress space of the calling process, Read information from the standard input and write to the shared memory, Read the content of the shared memory and write on to the standard output, Delete the shared memory

Subject Name: IT Workshop Lab
Subject Code: IT(EC)591
Credits: 2

Prerequisite - Computer Fundamentals and principles of computer programming
Course Outcomes (COs):
After attending the course students should be able to
CO-1: Demonstrate a thorough understanding of modular programming by designing programs that requires the use of programmer-defined functions.
CO-2: Demonstrate a thorough understanding of arrays by designing and implementing programs that search and sort arrays.
CO-3: Demonstrate a thorough understanding of the object-oriented programming concepts of encapsulation, data abstraction and composition by designing and implementing classes including the use of overloaded functions and constructors.
CO-4: Demonstrate a thorough understanding of the concept of pointers and dynamic memory allocation, the implementation of programmer-defined functions and classes by writing code, performing unit testing and debugging of multiple complex programs.
CO-5: Demonstrate a thorough understanding of the concept of pointers and dynamic memory allocation, the implementation of programmer-defined functions and classes by writing code, performing unit testing and debugging of multiple complex programs.

CO- PO Mapping:

COs/ POs	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	2	-	-	-	-	-	-	-
CO2	2	3	2	2	1	-	-	-	-	-	-
CO3	3	2	3	3	2	-	-	-	1	-	-
CO4	2	3	3	3	1	-	-	-	1	-	-
CO5	3	2	3	3	2	-	-	-	2	-	-

Course Content:
1. Introduction of UNIX/Linux Operating System which includes preliminary commands, start-up & shutdown methodology, file structure.
2. Handling as well as introduction to editors like Vi editor, introduction to GNU C & C++ compiler
3. Introduction to C++, basic loop control, executing programs.
4. Writing functions, selection statements, review of functions and parameters, command line arguments, recursion, I/O streams, arrays and string manipulation, pointers, structures & unions.
5. Object-Oriented Programming in C++, fundamentals of classes, constructors-destructors.
6. Dealing with member functions, operator overloading and polymorphism (both static & dynamic). 7. Dealing with inheritance, derived class handling.
8. Abstract class, virtual class, overriding, template class, name space & exception handling.
9. Dynamic memory allocation, implementation of Linked Lists, using C++.
10. MATLAB Environment, variable, constant, operators, loop, function.
11. MATLAB Toolbox, MATLAB Graphic function.
12. Reading and Writing to file, Numerical simulation.

13. Fundamentals of Python Programming with examples variables, data types, operators, control flow (conditionals and loops), functions, and data structures (lists, tuples, dictionaries, sets)

Text Books

1. The C++ Programming Language by Bjarne Stroustrup Addison-Wesley publisher

2. Object-Oriented Programming in C++ b by Robert Lafore Publisher: Sams

Reference Books

1. Object Oriented Programming with C++ by Balagurusamy McGraw Hill Education; Sixth edition Addison-

Wesley publisher

2. Object-Oriented Programming in C++ b by Robert Lafore Publisher: Sams

3. MATLAB Getting Started Guidehttps://www.mathworks.com/help/pdf_doc/matlab/getstart.pdf

Subject Name: Mini Project
Subject Code: EC581
Credits: 2

Guidelines:

1. The mini-project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.
2. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.
3. Mini Project should cater to a small system required in laboratory or real life.
4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.
6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.
9. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.
10. The tutorial sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation /report writing.

Course Outcomes: At the end of the course, students will be able to:

CO1. Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
CO2. Design, implement and test the prototype/algorithm in order to solve the conceived problem.
CO3. Write comprehensive report on mini project work.

3rd Year 6th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC601	VLSI Design	3	0	0	3	3
2	ENGG	Major	EC602	Computer Network	3	0	0	3	3
3	ENGG	Major	EC603A	Introduction to IoT	3	0	0	3	3
			EC603B	Digital Image Processing					
			EC603C	Drone Technologies					
			EC603D	Advanced Communication					
4	ENGG	Major	EC604A	Adaptive Signal Processing	3	0	0	3	3
			EC604B	Automotive Electronics					
			EC604C	Industrial Automation & Robotics					
			EC604D	EDA					
5	ENGG	Minor	EC605A	Nanotechnology	3	0	0	3	3
			CS(EC)605B	Artificial Intelligence & Machine Learning					
			CS(EC)605C	Software Engineering					
			EE(EC)605D	Renewable Energy and Sustainable Development					
6	HUM	Value Added Course	HU602	Research Methodology and IPR	1	0	0	1	1
B. PRACTICAL									
1	ENGG	Major	EC691	VLSI Design Lab	0	0	3	3	1.5
2	ENGG	Major	EC692	Computer Network Lab	0	0	3	3	1.5
3	ENGG	Major	EC693A	Introduction to IoT	0	0	3	3	1.5
			EC693B	Digital Image Processing Lab					
			EC693C	Drone Technologies Lab					
			EC693D	Advanced Communication Lab					
4	ENGG	Major	EC694A	Adaptive Signal Processing Lab	0	0	3	3	1.5
			EC694B	Automotive Electronics Lab					
			EC694C	Industrial Automation & Robotics Lab					
			EC694D	EDA Lab					

5	PRJ	Project	EC681	Project-I	0	0	0	8	4
C. MANDATORY ACTIVITIES/COURSES									
1	Mandatory Course	MC	MC681	NSS/NCC/Physical Activities/ Meditation & Yoga /Club Activities/Environmental Protection Initiatives	0	0	0	0	0
Total of Theory, Practical								**36**	**26**

Subject Name: VLSI Design
Subject Code: EC601
Credit: 3
Total Contacts: 36

Prerequisites: Basic concept of Electronic Devices, Analog & Digital Electronic Circuits. Course Objectives: Students will learn about integrated circuit design and VLSI technology.

1. **To introduce the fundamentals of VLSI systems and MOS devices.**
2. **To understand CMOS circuit design and layout techniques.**
3. **To learn the principles of combinational and sequential logic design.**
4. **To familiarize with design rules and hierarchical design.**
5. **To expose students to VLSI methodologies, FPGA/ASIC flows, and CAD tools.**

Course Outcomes (COs)

Graduates of the ECE program will be able to:
CO1: illustrate scale of integration – SSI, MSI, LSI, VLSI, Moor's Law, scaling, short channel effect, VLSI design flow, FPGA architecture, classify Standard IC & ASIC.
CO2: explain MOS diode, current source/sink & current mirror circuit, voltage/current reference circuits, switched capacitor circuit, design of CMOS differential amplifier based on the concept of large signal & small signal model of MOSFET.
CO3: analyze voltage transfer characteristics of inverter circuit and schematic level design of combinational & sequential digital circuit based on the knowledge of digital circuit design methodology like – static CMOS, Pseudo-NMOS, DCVSL, Pass transistor, TG, dynamic logic, NORA.
CO4: describe the stick diagram & layout of CMOS inverter & universal gates based on lambda and micron design rules.
CO5: estimate dynamic power, short circuit power, leakage power, total power consumption and the gate delay of CMOS inverter circuit with the help of switching activity, saturation & linear region current equations of MOSFETs and principle of charging & discharging of capacitor.

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	3	2	2	2	-	-	-	-	3
CO2	-	3	3	2	2	2	-	-	-	-	3
CO3	3	3	3	2	2	2	-	-	-	-	3
CO4	-	-	-	3	-	-	-	-	-	-	3
CO5	3	-	-	-	3	-	-	-	2	-	3

Module I: Introduction to IC [3]

Integrated Circuits – Advantages, disadvantages, limitations; Scale of Integration – SSI, MSI, LSI, VLSI, ULSI; Moor's Law; VLSI design flow, Y- Chart, IC Classification – Standard IC and ASIC, PAL, PLA, FPGA Architecture.

Module II: Inverter Characteristics [3]

Resistive load inverter – Voltage transfer characteristics (VTC, significance of parameters (only expression, no derivation) –VIL, VIH, VOL, VOH, Vth; CMOS inverter - VTC, Noise margin and aspect ratio of symmetric CMOS inverter.

Module III: Analog VLSI Circuit Design [11]

Analog sub-circuits -MOS Switch, Active resistors/MOS Diode, Current source and Sink, Current Mirror; Current and voltage references, Band gap reference; Switch-Capacitor Circuit – resistance emulation of series, parallel and series-parallel circuit, Switch capacitor integrator and filter (1st order only) ;CMOS differential amplifier – design parameters, DC analysis and AC analysis using large signal and small signal model of MOSFET. Block diagram of two stage CMOS OP-AMP (description only).

Module IV: Digital VLSI Circuit Design [12]

Combinational Logic Circuit Design: Circuit design using Static CMOS style – basic gates, design of circuit for product of sum (POS) and sum of product (SOP) expression, Circuit design using pseudo NMOS logic, DCVSL Logic, Pass Transistor Logic, Complementary pass transistor logic, TG Logic, Dynamic logic, domino logic, NORA logic.

Sequential Circuit and Semiconductor Memory Design: Bistable Circuit -Design of CMOS S-R & J-K Latch, CMOS Clocked SR & JK Latch /Master –slave JK Flip-flop, CMOS D Flip- flop; 6T SRAM cell and 3T DRAM cell design.

Module V: Layout of ICs [3]

Micron and lambda design rules; Stick diagram and Layout - CMOS Inverter, NAND and NOR gate.

Module VI: Power Consumption and Delay in VLSI Circuit Design [4]

Dynamic power, short circuit power and leakage power in CMOS Inverter; Timing parameters (concept only) –Critical path, arrival time, slack, skew, set-up time, hold time, Gate delay and path delay, delay time expression of CMOS inverter (expression only).

Textbooks:

1. **Digital Integrated Circuit, J.M.Rabaey, Chandrakasan, Nicolic, Pearson Education.**
2. **CMOS Digital Integrated Circuits Analysis and Design ,S.M.Kang&Y.Leblebici,TMH.**
3. **CMOS Analog Circuit Design , Allen &Holberg , Oxford**

4. **Design of Analog CMOS Integrated Circuits, BehzadRazavi , TMH .**

References:

1. **Microelectronic Circuits, Sedra& Smith, Oxford**
2. **Introduction to VLSI Circuits and System, Uyemura , Wiley**
3. **VLSI Design, Debaprasad Das, Oxford**
4. **VLSI Design and EDA Tools ,Angsuman Sarkar , Swapnadip De , C.K. Sarkar , Scitech.**
5. **VLSI Design Techniques for Analog and Digital Circuits , Geiger , Allen , Strader , TMH**

Subject Name: Computer Network
Subject Code: EC602
Credit: 3
Total Contact Hours: 36
Prerequisite: Digital Communication

Course Objectives: The course aims to provide a strong foundation in the principles of data communication and computer networks, including network architectures, protocols, and models. It also focuses on routing, congestion control, and network security concepts essential for understanding modern communication systems.

Course Outcomes:

Graduates of the ECE program will be able to

CO1: Understand the fundamentals of data communication, network types, topologies, protocols, and reference models

CO2: Analyze error control, flow control and medium access protocols and apply them in networking scenarios

CO3: Demonstrate IP addressing, routing algorithms and transport layer protocols and evaluate their effectiveness in real networks

CO4: Compare symmetric and asymmetric encryption techniques and assess cybersecurity threats, digital signatures and firewall configurations

Course Content:

Module 1: Overview of Data Communication [4L]

Introduction; physical structure (type of connection, topology), categories of the network (LAN,MAN, WAN); Internet: brief history, Protocols, and standards; Reference models: OSI referencemodel, TCP/IP reference model, their comparative study.

Module 2: Data Link Layers [9L]

Physical Layer: Transmission media (guided & unguided); Circuit switching time division & space division switch, ADSL Modem. Data link Layer: Types of errors, framing (character and bit stuffing), error detection & and

correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back-N ARQ, Selective repeat ARQ, Medium Access sublayer: Point to Point Protocol, Token Ring; Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet (basic idea).

Module 3: Network Layers [12L]

Network layer: Internetworking & devices: Hubs, Bridges (Basic Idea), Switches, Router, Gateway; Addressing: IP addressing, subnetting; Routing: techniques, static vs. dynamic routing, Source and Hop-by-routing (Dijkstra,), Unicast Routing Protocols: RIP, OSPF, Other Protocols: ARP, IPV6 (Basic idea), compare between IPv4 and IPv6, Router configuration (basic idea)

Transport layer: Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets (Concept); Leaky bucket algorithm, Token bucket algorithm.

Module 4: Application Layers [11L]

Application Layer: Introduction to DNS, HTTP & WWW, Bluetooth, and WLAN (Basic Idea) Need for Security, Security Attacks, Cyberattacks (Chosen plaintext, known plaintext , chosen ciphertext), Information Security, Methods of Protection. Symmetric Key Encryption: Data Encryption Standard (DES) Algorithm, Security of the DES, Advanced Encryption Standard (AES) Algorithm, DES and Comparison.

Public Key Encryption: Characteristics of Public Key System, RSA Technique, Cryptographic Hash Functions, Digital Signature Threats to E-Mail, Requirements and Solutions, Encryption for Secure E-Mail, Firewalls–Types, Firewall Configurations.

Text Books:

1. B.A. Forouzan –“Data Communications and Networking (3rd Ed.)“–T MH
2. A.S. Tanenbaum–“Computer Networks (4th Ed.)”–Pearson Education/PHI
3. W. Stallings–“Data and Computer Communications(5thEd.)”–PHI/Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP

Reference Books:

1. Kurose and Rose–“Computer Networking-A top down approach featuring the internet”–
Pearson Education
2. Leon, Garica, Widjaja–“Communication Networks”–TMH
3. Walrand–“Communication Networks”–TMH.

CO-PO-PSO Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	–	–	–	–	–	–	2	–
CO2	3	3	3	2	2	–	–	–	–	–	–
CO3	3	3	3	2	2	–	–	–	–	2	–
CO4	2	2	2	–	2	2	2	2	–	–	–

Course Name: Introduction to IOT
Course Code: EC603A
Credits: 3
Total Contact Hours: 36

Prerequisite: Sensors, Actuators, Microcontroller, Computer Networks

Course Objectives: The purpose of this course is to gather knowledge about IoT, its architecture different software and hardware components of IoT. Finally students will apply such knowledge to design some hands-on models showcasing different IoT applications.

Course Outcomes:
Graduates of the ECE program will be able to
CO1: Understand Internet of Things and its hardware and software components.
CO2: Apply interface I/O devices, sensors & communication modules.
CO3: Analyze remotely monitor data and control devices.
CO4: Create real life IoT based projects.

Course Content

Module 1: **10L**
Introduction to IoT: Architectural Overview, IoT Enablers, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and Gateways, Data management, Idea of Cloud, Edge and Fog computing, Role of Cloud in IoT, Services offered by Cloud, Security aspects in IoT.

Module 2: **10L**
Elements of IoT: Hardware Components- Arduino, Raspberry Pi development board,

Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Embedded C/Python/Node.js) for Communication and Network Protocols - RFID, ZigBee, Bluetooth, BLE, MQTT, CoAP, TCP/IP, UDP

Module3: **10L**
It Application Development: Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices. Use of AI and ML in IoT

Module 4: **6L**
IoT Case Studies and mini projects based on Industrial Automation, Transportation, Agriculture, Healthcare, Home Automation.

Textbooks and Reference Books:
1. Introduction to IoT by SudipMisra, AnandarupMukherjee,Arijit Roy ,1st Edition Cambridge University Press.
2. Vijay Madisetti, ArshdeepBahga, Ïnternet of Things, "A Hands on Approach", University Press
3. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill
4. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
5. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
6. Adrian McEwen, "Designing the Internet of Things", Wiley
7. CunoPfister, "Getting Started with the Internet of Things", O Reilly Media
8. Dr. SRN Reddy, RachitThukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	2	-	-	-	-	-	-	2
CO2	2	3	1	2	1	-	-	-	1	-	2
CO3	3	2	2	3	2	-	-	-	-	-	2
CO4	2	3	3	3	1	-	-	-	2	-	2

Subject name: Digital Image Processing
Code: EC603B
Credits: 3
Total contact hours: 36

Course Outcome:

Graduates of the ECE program will be able to:
CO1 – Implement different filtering techniques to enhance the quality of images and videos
CO2 – Apply different image processing techniques to compress and segment images
CO3 – Illustrate image processing algorithms to secure images
CO4 – Analyze the performance of various algorithms in video processing

Course Content:

Module 1: [5L]

Digital Imaging Fundamentals: Basic idea of Digital image, Pixel, Mathematical operation of Digital Image, Sampling, Quantization, application of digital Image Processing [3]

Transform of Digital Images: Importance of Digital Image Transform, Application of Digital Image Transform in different area [2]

Module 2: [7L]

Digital Image Enhancement: Importance of Digital Image enhancement, enhancement in spatial and frequency domain, Bit plane slicing, Histogram, Histogram Equalization, Mean and Median filtering in Digital Images, Frequency domain filtering in Digital Images – LPF,HPF and BPF

Module 3: [5L]

Digital Image Compression: Importance of Digital Image Compression, Types of Image Compression, example of lossless and lossy compression, Image compression standards, Compression in spatial domain, Wavelet based Digital image compression

Module 4: [8L]
Segmentation of Digital Images: Importance and applications of Digital Image Segmentation, Detection of discontinuities, Segmentation based on Thresholding and Region Growing

Edge detection in Digital Image Processing: Importance of Edge detection in Digital Image Processing, Types of Edge Detection-sobel, canny and prewitt edge detection techniques and mathematical Equation of each operator.

Module 5: [4L]

Security in Digital Image Processing: Introduction to Digital Image Security and its application, Image encryption in spatial and frequency Domain. Basic idea on CryptographySteganography and Watermarking for digital image.

Module 6: [7L]

Introduction of Video Processing: Basic Steps of Video Processing: Analog video, DigitalVideo, Time varying Image Formation models, Geometric Image formation, filtering operations [3].

Application of Artificial Intelligence/ Machine Learning in Image and Video Processing[2].

2-D Motion Estimation: Optical flow, general methodologies, pixel-based motion estimation, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation [2].

Textbooks:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.

2. S. Annadurai,R. Shanmugalakshmi, "Fundamentals of Digital Image Processing", Pearson Education, 2006

3. Yao wang, JoemOstarmann and Ya–quin Zhang,"Video processing and communication",,PHI

References:

1. .Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.

2. AnilJain K. "Fundamentals of DigitalImage Processing", PHI Learning Pvt. Ltd., 2011. 3. Willliam K Pratt, "Digital Image Processing",JohnWilley, 2002.

4.Pakhira,"DigitalImageProcessingandPatternRecognition",FirstEdition,PHILe arningPvt.Ltd.,2011.

5. M. Tekalp ,"Digital video Processing", Prentice Hall International

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO10	PO11
CO1	3	-	1	-	-	2	-	2	-	-	3
CO2	-	3	-	2	-	1	-	-	2	-	2
CO3	2	-	1	-	1	-	3	-	-	2	3
CO4	3	-	1	-	-	-	2	1	-	-	2

Course Name:Drone Technology
Course Code: EC603C
Semester: 6th
Year: 3rd Year
Lecture Hours: 3
Credits: 3

Course Description:

This course introduces fundamental concepts of drone technology, covering the architecture, components, control systems, sensors, communication, navigation, and applications of drones in various fields. Students will gain hands-on experience through lab exercises involving drone flight simulation, programming, and sensor integration.

Course Objectives:

- Understand the basics of drone systems and their components
- Learn drone flight dynamics and control algorithms
- Study sensor technologies used in drones
- Explore communication and navigation techniques
- Apply knowledge through practical lab sessions on drone programming and operation

Course Outcomes (CO):

CO No	Course Outcome Description
CO1	Describe the architecture and components of drones
CO2	Understand and analyze flight dynamics and control systems
CO3	Explain sensor technologies and integration in drones
CO4	Implement communication and navigation systems in drones
CO5	Perform basic programming and simulation of drone operations
CO6	Understand real-world applications and challenges of drones

CO-PO mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	1	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-
CO3	-	1	1	1	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-
CO5	1	1	-	-	1	-	-	-	-	-	-
CO6	1	1	1	1	-	-	-	-	-	-	-

Detailed Syllabus:

UNIT 1: Introduction to Drones and UAVs 5L

- History and evolution of drones
- Classification and types of drones (fixed-wing, rotary-wing, hybrid)
- Basic drone components: frame, motors, ESC, propellers, batteries, flight controller
- Applications of drones in various fields

UNIT 2: Aerodynamics and Flight Dynamics 6L

- Basics of aerodynamics relevant to drones
- Forces acting on drones: lift, drag, thrust, weight
- Stability and control: pitch, roll, yaw
- Flight modes and manoeuvres
- Flight control systems overview

UNIT 3: Sensors and Actuators for Drones 5L

- Sensors: IMU (Gyroscope, Accelerometer), Magnetometer, Barometer, GPS, LIDAR, Cameras
- Actuators: brushless motors, ESCs
- Sensor fusion and data filtering (e.g., Kalman Filter basics)
- Integration challenges

UNIT 4: Communication and Navigation Systems 5L

- Drone communication protocols: RF, WiFi, Bluetooth, 4G/5G
- Telemetry and control link
- GPS-based navigation and waypoint systems
- Introduction to autonomous navigation and path planning basics

UNIT 5: Drone Programming and Simulation 6L

- Introduction to drone programming platforms (e.g., Drone Kit)
- Basics of flight control programming
- Simulation tools: PX4 SITL, Mission Planner
- Safety, regulations, and ethics in drone operation

UNIT 6: Applications and Future Trends 6L

- Drones in agriculture, surveillance, delivery, disaster management
- Emerging technologies: swarm drones, AI integration, BVLOS (Beyond Visual Line of Sight)
- Challenges and future prospects

References/Text Book:

1) "Introduction to UAV Systems"
- **Author:** P.J. Swamy
- **Publisher:** BS Publications

2) "Fundamentals of UAVs and Drones: An Engineering Approach"
- **Author:** K. V. Ramana
- **Publisher:**Scitech Publications

3) **"UAV Systems Design, Development and Deployment"**
- **Author:**Reg Austin
- **Publisher:** Wiley

4) **"Drone Programming with Python and ROS"**
- **Author:** Dinesh Ayyappan
- **Publisher:** BPB Publications (Indian edition available)

Course Name: Advanced Communication
Course Code: EC603D
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3
Prerequisite: Digital Communication, Field Theory, Signal and Systems

Objective

1. Understanding of the main concepts and techniques used in the analysis and design of digital communication systems.
2. Help students to design complex circuits in digital communication.

Outcome

On completing this subject the student should be able to:

CO1: Qualitatively and quantitatively analyse and evaluate digital communication systems;
CO2: Use software tools to analyse, design and evaluate digital communication systems
CO3: Compare different digital communication techniques and judge their applicability and performance in different application scenarios.
CO4: Formulate advanced mathematical models which are applicable and relevant in the case of a given problem.
CO5: Use efficiently mathematical model to solve a given demanding engineering problem in the field, and analyze the result and its validity.

Module 1:
Fourier Expansion, Fourier transform, Normalized power spectrum, Power spectral density, Effect of transfer function on output power spectral density, Perseval's theorem. Autocorrelation & cross correlation between periodic signals, cross correlation power. Relation between power spectral density of a signal, its autocorrelation function and its spectrum. Distinction between a random variable and a random process. Probability, sample space, Venn diagram, joint probability, bay's theorem, cumulative probability distribution function, probability density function, joint cumulative probability distribution function, joint probability density function. Mean/average/expectation of a random variable and of sum of random variables. Standard deviation, variance, moments of random variables, explanation with reference to common signals. Tchebycheff's inequality. Gaussian probability density function – error function & Q function Central limit theorem.
Spectral analysis of signals:
Orthogonal & orthonormal signals. Gram-Schmidt procedure to represent a set of arbitrary signals by a set of orthonormal components; - numerical examples. The concept of signal-space coordinate system, representing a signal vector by its ortho-normal components, measure of distinguishability of signals.

Line codes: UPNRZ, PNRZ, UPRZ, PRZ, AMI, Manchester etc. Calculation of their power spectral densities. Bandwidths and probabilities of error (P_e) for different line codes.
Revision of digital modulation: Principle, transmitter, receiver, signal vectors, their distinguish ability (d) and signal band width for BPSK, QPSK, M-ARY PSK, QASK, MSK, BFSK, M-ARY FSK.

Module 2

Spread spectrum modulation: Principle of DSSS, processing gain, jamming margin, single tone interference, principle of CDMA.
Multiplexing & multiple access: TDM/TDMA, FDM/FDMA, Space DMA, Polarization DMA, OFDM, ALOHA, Slotted ALOHA, Reservation ALOHA, CSMA-CD, CSMA-CA – basic techniques and comparative performances e.g. signal bandwidth, delay, probability of error etc.

Module 3
Base band signal receiver and probabilities of bit error: Peak signal to RMS noise output ration, probability of error. Optimum filter, it's transfer function. Matched filter, it's probability of error. Probability of error in PSK, effect of imperfect phase synchronization or imperfect bit synchronization. Probability of error in FSK, QPSK. Signal space vector approach to calculate probability of error in BPSK, BFSK, QPSK. Relation between bit error rate and symbol error rate. Comparison of various digital modulation techniques vis-Ã -vis band width requirement and probabilities of bit error.

Characteristics of random variables and random processes:
Common probability density functions, - Gaussian, Rayleigh, Poisson, binomial, Rice, Laplacian, log-normal, etc. Probability of error in Gaussian Binary symmetric channel. Random processes –time average, ensemble average, covariance, autocorrelation, cross correlation, stationary process, ergodic process, wide sense stationary process. Power spectral density and autocorrelation, power spectral density of a random binary signal. Linear mean square estimation methods.

Revision of source coding: Sampling theorem, instantaneous/ flat top/ natural sampling, band width of PAM signal, quantization, quantization noise, principle of pulse code modulation, delta modulation& adaptive delta modulation. Parametric coding/ hybrid coding/ sub band coding: APC, LPC, Pitch predictive, ADPCM, voice excited vocoder, vocal synthesizer.

Module 4

Noise: Representation of noise in frequency domain. Effect of filtering on the power spectral density of noise – Low pass filter, band pass filter, differentiating filter, integrating filter. Quadrature component of noise, their power spectral densities and probability density functions. Representation of noise in orthogonal components.

Text Books:
1. Digital communication, 4th ed. - J. G. Proakis, MGH International edition.
2. Principle of Communication Systems – Taub, Schilling, TMH
3. Digital and Analog Communication Systems, 7th ed. – Leon W. Couch, PHI.
4. Principles of Digital Communication – Haykin
5. Digital Communication – Zeimer, Tranter.
6. Principle of Digital communication - J. Das, S. K. Mallick, P. K Chakraborty, New Age Int.
7. Communication Systems, 4th ed. – A. Bruce Carlson, Paul B. Crilly, Janet C. Rutledge, MGH International edition.

8. Digital Communications, 2nd ed. – Bernard Sklar, Pearson Education.
9. Electronic Communications, 4th ed. – Dennis Roddy, John Coolen, PHI

CO-PO Mapping:

CO\PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	3	-	-	-	-	-	-	-
CO2	2	2	3	2	3	-	-	-	-	2	-
CO3	3	2	2	3	-	-	-	-	-	2	-
CO4	3	3	2	3		-	-	-	-	-	-
CO5	3	3	3	3	2	-	-	-	-	2	-

Subject: Adaptive Signal Processing
Course Code: EC604A
Credits: 3
Total Contact Hours: 36

Prerequisite: Digital Signal Processing (EC503)

COs and CO-PO Mapping:

CO No.	Course Outcome(After the completion of the course , students will be able to)
CO1	Understand the fundamentals and motivations behind adaptive signal processing.
CO2	Analyse and implement the Least Mean Square (LMS) algorithm and its variants.
CO3	Apply Recursive Least Squares (RLS) algorithm in adaptive filtering problems.
CO4	Design and evaluate adaptive filters for noise cancellation, prediction, and system identification.
CO5	Simulate adaptive algorithms using MATLAB or equivalent tools.

COs → POs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	-	-	-	-	-	-
CO2	3	3	2	2	1	-	-	-	-	1	-
CO3	3	3	3	2	2	-	-	-	-	1	-
CO4	2	3	3	2	2	-	-	-	-	2	-
CO5	1	2	2	3	3	-	-	-	-	2	-

Course Content:

Module 1: Introduction to Adaptive Systems [6 Hours]

- Definitions and characteristics
- Comparison of adaptive and non-adaptive systems
- Applications of adaptive filters (Noise cancellation, system identification, echo cancellation, channel equalization)

- Motivation and real-world examples

Module 2: Mathematical Foundations and Performance Metrics [6 Hours]

- Stochastic processes and signal modeling
- Correlation and autocorrelation
- Stationarity and ergodicity
- Performance metrics: convergence, misadjustment, excess MSE
- Optimization concepts in adaptive systems

Module 3: Least Mean Square (LMS) Algorithm [9 Hours]

- Derivation of LMS algorithm from steepest descent method
- Convergence analysis
- Learning rate parameters and trade-offs
- Normalized LMS (NLMS)
- Applications: adaptive noise cancellation, system modeling
- MATLAB implementation examples

Module 4: Recursive Least Squares (RLS) Algorithm [8 Hours]

- Problem formulation and derivation of RLS
- Matrix inversion lemma and algorithm steps
- Comparison between RLS and LMS
- Stability and complexity considerations
- Applications in real-time systems

Module 5: Advanced Topics and Applications [7 Hours]

- Affine Projection Algorithm (APA)
- Kalman Filter-based adaptation
- Adaptive IIR filters (conceptual overview)
- Use in wireless communication systems and biomedical signal processing
- Simulation of adaptive algorithms using MATLAB/Python

Textbooks & References:

1. **Simon Haykin**, *Adaptive Filter Theory*, 5th Edition, Pearson Education, 2014.
2. **Ali H. Sayed**, *Fundamentals of Adaptive Filtering*, Wiley-IEEE Press, 2003.
3. **B. Widrow and S.D. Stearns**, *Adaptive Signal Processing*, Pearson, 1985.
4. **S. Thomas Alexander**, *Adaptive Signal Processing: Theory and Applications*, Springer, 1986.
5. MATLAB documentation and MathWorks tutorials on adaptive filtering.

Subject Name: Automotive Electronics
Subject Code: EC 604B
Credits: 3
Total Contact Hours: 36

Pre-requisite: Students should have a solid understanding of basic knowledge of analog and digital electronics, fundamentals of microcontrollers and basic automotive systems, especially in terms of I/O interfacing and embedded system basics. Additionally, a general awareness of automotive systems such as the internal combustion engine, transmission, braking, and steering mechanisms will be beneficial for contextual learning.

Course Objectives:
- To provide an overview of the electronics used in the automotive industry.
- To familiarize students with sensors, actuators, and control units used in vehicles.
- To impart knowledge on various subsystems such as engine management, chassis electronics, and safety systems.
- To introduce communication protocols and diagnostics in automotive networks.

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

- CO1: Understand the architecture of automotive electronic systems and their functional elements.
- CO2: Identify and analyze various automotive sensors and actuators used in electronic control units.
- CO3: Explain the functioning of engine management and emission control systems.
- CO4: Evaluate safety and comfort electronic systems in vehicles.
- CO5: Apply in-vehicle networking and diagnostic protocols in automotive applications.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	-	-	-	-	1	1	1
CO2	3	2	2	2	1	-	-	-	2	1	1
CO3	3	2	2	2	1	-	-	-	2	1	1
CO4	3	2	2	2	1	-	-	-	2	1	1
CO5	2	2	3	2	1	1	1	-	2	1	1

Course Content

Module I: INTRODUCTION TO AUTOMOTIVE ELECTRONICS [6L]
Overview of automotive systems: engine, transmission, steering, braking, suspension, and safety. Introduction to electronic control in modern vehicles. Need and benefits of electronics in automobiles. Electronic Control Unit (ECU) architecture and functions.

Module II: SENSORS AND ACTUATORS IN AUTOMOTIVE SYSTEMS [6L]
Automotive sensors: temperature, pressure, position, oxygen, knock, speed, and flow sensors. Actuators: solenoids, stepper motors, DC motors, piezoelectric actuators. Sensor-actuator interface and signal conditioning.

Module III: ENGINE MANAGEMENT SYSTEMS [6L]
Electronic Fuel Injection (EFI) systems, ignition systems (TCI, CDI), closed-loop control using sensors, emission control, catalytic converter, onboard diagnostics (OBD-II), engine performance optimization.

Module IV: CHASSIS AND SAFETY ELECTRONICS [6L]
ABS, ESP, electronic power steering, suspension control, airbag systems, collision avoidance, electronic stability program. Role of microcontrollers in safety applications.

Module V: IN-VEHICLE NETWORKING & COMMUNICATION [5L]
Overview of in-vehicle networking. Communication protocols: CAN, LIN, FlexRay, MOST. ECU communication. Diagnostics and fault tolerance. Standard interfaces.

Module VI: INFOTAINMENT AND COMFORT ELECTRONICS [4L]
Audio/video systems, GPS navigation, telematics, HVAC control, lighting control, driver assistance systems (ADAS), heads-up displays, keyless entry, and smart dashboards.

Module VII: TRENDS IN AUTOMOTIVE ELECTRONICS [3L]
Electric and hybrid vehicle systems, battery management, vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, autonomous vehicles, cybersecurity in automotive systems.

Textbooks:

- William B. Ribbens, Understanding Automotive Electronics, 7th Edition, Butterworth-Heinemann.
- Robert Bosch GmbH, Automotive Handbook, 9th Edition.

Reference Books:

- Tom Denton, Automobile Electrical and Electronic Systems, 4th Edition, Routledge.
- K.K. Jain and R.B. Asthana, Automobile Electrical Equipment, Tata McGraw Hill.

Subject: Industrial Automation and Robotics
Paper Code: EC604C
Program: B.Tech in Electronics and Communication Engineering
Credits: 3
Total Contact Hours: 36

Prerequisites: Basic knowledge of control systems, sensors, and microcontrollers

CO No.	**Course Outcome(After the completion of the course, students will be able to)**
CO1	Understand the basic components and architecture of industrial automation systems.
CO2	Analyze the working of sensors, actuators, and controllers in automation and robotic systems.
CO3	Develop ladder logic programs for PLC-based control applications.
CO4	Understand the principles of robotic kinematics, control, and end-effectors.
CO5	Apply automation and robotic principles to real-world industrial problems.

COs ↓ / POs →	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	3	2	2	2	-	-	-	-	1	1
CO3	2	3	3	2	2	-	-	-	-	1	2
CO4	3	3	2	2	2	-	-	-	-	2	2
CO5	3	3	3	3	3	-	-	-	2	2	3

Course Content:

❖ **Module 1: Introduction to Industrial Automation [6 Hours]**

- Overview of industrial automation: need, scope, and applications
- Types of automation: Fixed, Programmable, Flexible
- Automation hardware: sensors, actuators, control systems
- Industrial control systems: introduction to SCADA, DCS, and HMI
- Role of IoT and Industry 4.0 in automation

❖ **Module 2: Programmable Logic Controllers (PLCs) [8 Hours]**

- Architecture of PLC
- Types of I/O modules, CPU, memory
- Ladder Logic Programming: basic instructions, timers, counters
- PLC interfacing and communication protocols
- Case studies: PLC-based automation systems

❖ **Module 3: Sensors and Actuators in Automation [7 Hours]**

- Classification and characteristics of sensors: position, proximity, temperature, force, pressure
- Actuators: pneumatic, hydraulic, electric motors, stepper motors, servo motors
- Signal conditioning and data acquisition

- Interfacing sensors and actuators with microcontrollers/PLCs

❖ **Module 4: Robotics Fundamentals [8 Hours]**

- Introduction to robotics: definition, classification, and applications
- Robot anatomy: joints, links, and workspace
- Kinematics of robots: forward and inverse kinematics
- End-effectors and grippers
- Robotic drive systems and control

❖ **Module 5: Robot Programming and Industrial Applications [7 Hours]**

- Introduction to robot programming languages (RAPID, VAL, AML)
- Offline programming and simulation tools
- Industrial applications: pick-and-place, welding, painting, packaging
- Human-Robot Interaction (HRI), collaborative robots (cobots)
- Future trends: AI in robotics, autonomous robots

Recommended Textbooks & References:

1. **Mikell P. Groover**, *Automation, Production Systems and Computer-Integrated Manufacturing*, Pearson Education
2. **John J. Craig**, *Introduction to Robotics: Mechanics and Control*, Pearson
3. **Frank D. Petruzella**, *Programmable Logic Controllers*, McGraw Hill
4. **S. R. Deb and S. Deb**, *Robotics Technology and Flexible Automation*, McGraw Hill
5. **W. Bolton**, *Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering*, Pearson.

Course Name: Electronic Design Automation (EDA)
Course Code: EC604D
Contact: (L:T:P) : 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Basic Concepts of Digital and Analog Electronics

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

CO1: Understand the need for Electronic Design Automation (EDA) tools and explain the role of various EDA tools in digital system design. **(Mapped to Module I)** → Cognitive Level: Understand
CO2: Apply high-level synthesis techniques such as control/data flow graphs, scheduling, and logic synthesis for digital system modeling and optimization. **(Mapped to Module II)**→ Cognitive Level: Apply
CO3: Analyze and implement the physical design process including partitioning, floor planning, placement, and routing with suitable algorithms. **(Mapped to Module III)**→ Cognitive Level: Analyze
CO4: Understand timing analysis using SPICE simulations and estimate delays using logical and electrical efforts; evaluate transistor-level timing parameters. **(Mapped to Module IV)**→ Cognitive Level: Apply / Evaluate
CO5: Explain VLSI testing techniques and evaluate the fault coverage of different Design-for-Testability (DFT) methods including BIST, scan test, and ATPG. **(Mapped to Module V)** → Cognitive Level: Understand / Evaluate
CO6: Design and simulate digital systems using VHDL in various modeling styles (dataflow, structural, behavioral) with testbenches and timing models. **(Mapped to Module VI)**→ Cognitive Level: Create / Apply

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	1	3	-	-	-	1	1	1
CO2	3	3	3	2	3	-	-	-	2	1	2
CO3	3	3	3	2	3	-	-	-	2	1	2
CO4	3	2	2	3	3	-	-	-	1	1	2
CO5	3	3	2	2	3	2	1	1	2	1	2
CO6	3	3	3	2	3	1	-	-	2	2	2

Course Content:

Module I: Introduction to EDA **[5L]**

The need for EDA, Hardware description languages, The design process Semi-custom design tools, Design entry, Design verification, Design layout, Full custom design tools, Design entry, Design layout, Design verification, Low- and high-level tools

Module II: Introduction to Synthesis **[6L]**

Introduction –High level synthesis – Control and Data flow graph, scheduling, allocation & binding, Logic synthesis -gate level optimization, technology mapping, BDD, ROBDD

Module III: Physical Design Automation [8L]

Partitioning -level of partioning, partitioning algorithm; Floor planning – input, output & objectives with example, cost estimation of floorplan, dead space, slicing & non-slicing floorplan, , Floor planning algorithm, pin assignment; Placement – objectives , placement problem at different levels (system , board & chip),Routing- Global , Detailed routing.

Module IV: Timing Analysis [5L]

A brief history of SPICE, Types of analysis using SPICE, DC analysis AC analysis Transient analysis, obtaining results, DC convergence problems, Transient analysis problems Slew balancing, transistor equivalency, design of basic gates for equal rise and fall time, intrinsic delay, parasitic delay, logical effort, electrical effort, D algorithm

Module V: Testing of VLSI Circuit [6L]
Introduction, Importance of Testing, Fault Models, Fault Simulation, Design for Testability, Ad Hoc Testing, Scan Test, Boundary Scan Test, Built-in Self-Test, Automatic Test-pattern Generation.

Module VI: Design using VHDL [6L]

Introduction to VHDL, library VHDL design architecture various statement (if else, process, wait, others) signal, variable, component and port map, different description / modelling (dataflow, structural, behavioral, mixed), delay model, design example –combinational and sequential circuits.

<u>Textbooks:</u>

1. Algorithm for VLSI Physical Design Automation, Naveed A. Sherwani
2. Electronic Design Automation: Synthesis, Verification, and Test (by Laung-Terng Wang (Editor), Yao-Wen Chang
(Editor), Kwang-Ting (Tim) Cheng (Editor)
3. CMOS: Circuit Design, Layout, and Simulation, J. Baker,Harry W. Li, David E. Boyce , Wiley–Blackwell
4. VLSI Design and EDA Tools, Angsuman Sarkar, Swapnadip De, C. K. Sarkar, Scitech
5. VLSI Design, Debaprasad Das, Oxford
6. Verilog HDL: A Guide to Digital Design and Synthesis Second Edition by Samir Palnitkar

<u>Reference Books:</u>

1. G.DeMicheli. Synthesis and optimization of digital circuits,
2. Digital Integrated Circuit, J.M.Rabaey, Chandrakasan, Nicolic, PearsonEducation

Subject Name: Nanotechnology
Subject Code: EC605A
Credit: 3
Total Contact: 36
Prerequisite: Learning of Solid State Device, VLSI Design
Course Outcomes:
At the end of the course, students will demonstrate the ability to:
1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
2. Apply the fundamentals of classical CMOS and MOSFET technology.
3. Apply the advantages of nano-technology to solve practical problems.
4. Apprehend the need of new device structure and Nano-materials.

Course Content:

Module 1: [8L]
Introduction to nanotechnology, mesostructures,Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. KronigPenny Model. Brillouin Zones.

Module 2: [10L]
Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, Hot electron effects in MOSFETs, limits to scaling, system integration limits (interconnect issues etc.)

Module 3: [12L]
Double barrier tunneling , Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors,Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation.

Module 4: [06L]
Nanotechnology: Deposition techniques for Nanoscale Devices, Nanolithography, Self-Assembly Techniques, Nanomaterials, Nanoparticles, Nanowires, Nanostructure Surfaces.

Textbooks:
1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.
3. Mitin, V. Kochelap, and M. Stroscio, “Introduction to Nanoelectronics”, Cambridge University Press, 2008

Reference Books:
1. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
2. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.

CO-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	2	-	1	-	-	2
CO2	3	3	3	3	2	3	-	-	-	2	2
CO3	3	2	3	3	3	3	-	-	-	1	2
CO4	3	2	2	3	2	2	-	1	-	-	2

Course Name: Artificial Intelligence and Machine Learning
Course Code: CS(EC)605B
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3
Pre-requisite: Basic 12 standard Physics and Mathematics, Concept of components of electronics circuit, Basic programming logic
Course objective:

1. ACQUAINT with fundamentals of artificial intelligence and machine learning.
2. LEARN feature extraction and selection techniques for processing data set.
3. UNDERSTAND basic algorithms used in classification and regression problems.
4. OUTLINE steps involved in development of machine learning model.
5. FAMILIARIZE with concepts of reinforced and deep learning.
6. IMPLEMENT AND ANALYZE machine learning model in Electronics and Communication Engineering problems.

Course outcomes:

On completion of the course, learner will be able to

CO1. DEMONSTRATE fundamentals of artificial intelligence and machine learning.
CO2. APPLY feature extraction and selection techniques, machine learning algorithms for classification and regression problems.
CO3. DEVISE AND DEVELOP a machine learning model using various steps.
CO4. EXPLAIN concepts of reinforced and deep learning.
CO5. SIMULATE machine learning model in Electronics and Communication Engineering problems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	2	2	3	2	-	2
CO2	3	3	3	1	3	3	-	3	-	3	3
CO3	3	3	3	1	3	3	-	3	1	3	3
CO4	3	3	-	3	-	2	2	3	3	-	3
CO5	3	3	-	1	3	3	-	3	-	2	2

Course Content:

MODULE 1:Introduction to AI & ML **6L**

History of AI, Comparison of AI with Data Science, Need of AI in Electronics and Communication Engineering, Introduction to Machine Learning.
Basics: Reasoning, problem solving, Knowledge representation, Planning, Learning, Perception, Motion and manipulation.
Approaches to AI: Cybernetics and brain simulation, Symbolic, Sub-symbolic, Statistical.
Approaches to ML: Supervised learning, Unsupervised learning, Reinforcement learning.

MODULE 2:Feature Extraction and Selection 4L

Feature extraction: Statistical features, Principal Component Analysis.

Feature selection: Ranking, Decision tree - Entropy reduction and information gain, Exhaustive, best first, Greedy forward & backward, Applications of feature extraction and selection algorithms in Electronics and Communication Engineering.

MODULE 3:Classification & Regression 6L

Classification: Decision tree, Random forest, Naive Bayes, Support vector machine.

Regression: Logistic Regression, Support Vector Regression.

Regression trees: Decision tree, random forest, K-Means, K-Nearest Neighbor (KNN). Applications of classification and regression algorithms in Electronics and Communication Engineering.

MODULE 4:Development of ML Model 7L

Problem identification: classification, clustering, regression, ranking. Steps in ML modeling, Data Collection, Data pre-processing, Model Selection, Model training (Training, Testing, K-fold Cross Validation), Model evaluation (understanding and interpretation of confusion matrix, Accuracy, Precision, Recall, True positive, false positive etc.), Hyper parameter Tuning, Predictions.

MODULE 5:Reinforced and Deep Learning 7L

Characteristics of reinforced learning; Algorithms: Value Based, Policy Based, Model Based; Positive vs Negative Reinforced Learning; Models: Markov Decision Process, Q Learning. Characteristics of Deep Learning, Artificial Neural Network, Convolution Neural Network. Application of Reinforced and Deep Learning in Electronics and Communication Engineering.

MODULE 5: Applications
6L

Human Machine Interaction, Predictive Maintenance and Health Management, Fault Detection, Dynamic System Order Reduction, Image based part classification, Process Optimization, Material Inspection, Tuning of control algorithms.

Textbooks:

1. D. Chattopadhyay, P.C Rakshit, “Electronics Fundamentals and Applications”, New Age International (P) Limited Publishers, Seventh Edition, 2006
2. Basic Electrical & Electronics Engineering by J.B. Gupta, S.K. Kataria& Sons, 2013.
3. Deisenroth, Faisal, Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
4. B Joshi, Machine Learning and Artificial Intelligence, Springer, 2020.
5. Parag Kulkarni and Prachi Joshi, “Artificial Intelligence – Building Intelligent Systems”, PHI learning Pvt. Ltd., ISBN – 978-81-203-5046-5, 2015.
6. Stuart Russell and Peter Norvig (1995), “Artificial Intelligence: A Modern Approach,” Third edition, Pearson, 2003.

Reference Books:

1. Solanki, Kumar, Nayyar, Emerging Trends and Applications of Machine Learning, IGI Global, 2018.
2. Mohri, Rostamizdeh, Talwalkar, Foundations of Machine Learning, MIT Press, 2018.

3. Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.
4. Zsolt Nagy - Artificial Intelligence and Machine Learning Fundamentals-Apress (2018)
5. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair, TMH

Web References:

1. http://nptel.ac.in/courses/111101003/
2. https://nptel.ac.in/courses/106/106/106106202/
3. https://nptel.ac.in/courses/112/103/112103280/
4. https://www.analyticsvidhya.com/

Course Name: Software Engineering Course
Code: CS(EC)605C
Contact: 3:0:0
Total contact Hours: 36
Credits: 3

Prerequisites: Mathematics, Data Structure and Basic Computations
Course Objectives: In this course, students will gain a broad understanding of the discipline of software engineering and its application to the development of and management of software systems. Knowledge of basic software engineering methods and practices and their appropriate application.

Course Outcomes:

After completion of this course student will be able to:
CO1: Ability to analysis and design of complex systems and meet ethical standards, legal Responsibilities.
CO2: Ability to apply software engineering principles, techniques and develop, maintain, Evaluate large-scale software systems.
CO3: To produce efficient, reliable, robust and cost-effective software solutions and perform independent research and analysis.
CO4: Ability to work as an effective member or leader of software engineering teams and manage time, processes and resources effectively by prioritizing competing demands to achieve personal and team goals.

Course Content:

Module 1:
Introduction: Definition of Software Engineering, Software crisis, Evolution of technologyHype curve, Exploratory style of Software development vs. Software Engineering, Human cognition mechanism, Software Engineering principle- abstraction and decomposition Software Development Life Cycle (SDLC) models: Water fall model, V-shape Model, PrototypingModel, Spiral Model, RAD Agile Model, Verification and Validation. **[6L]**
Module 2:
Software Project Management: Responsibility of a project manager, Project planning, Metrics for project size estimation, Project estimation techniques, COCOMO model, Halstead's Software Science, Scheduling-CPM, PERT, Gantt chart, Risk management, Software configuration management, Staffing and team leader project and planning Requirement analysis and specification: SRS, Requirement gathering and specification, Functional requirement, Traceability. **[10L]**
Module 3:
Software Design: Characteristics of a good software, Cohesion and coupling, Function oriented design-

DFD, Structure chart. Design phase in life cycle, System Design Definitions, Concept and methodologies, data flow oriented Design, Program Design and the requirements. Object oriented design- class and relationship, UML diagrams. Coding and Testing: Coding Standard, software documentation, Testing- unit testing, black box testing- equivalence class partitioning, boundary value analysis, white box testing- McCabe's Cyclometric Complexity, Mutation Testing, Debugging, Program analysis tool, Integration Testing, Grey box testing, System testing- Smoke and performance testing. **[15L]**

Module 4:

Software Reliability and Quality Management: Reliability, Hazard, MTTF, Repair and Availability, Software quality, Software reliability and fault-tolerance, six-sigma. Computer-aided software engineering: Computer-aided software engineering (CASE)- environment and benefit. Function point methods (FSM, ISO, OMG) & Metrics. Standards: Capability Maturity Model Integration, ISO 9001. **[5L]**

Text Books:

1. Rajib Mall: Software Engineering, PHI
2. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Seventh Edition, McGraw-Hill International Edition.

Reference Books Edition.:

1. Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.
2. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.
3. Software Engineering: Iyan Somarville, 7th

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	-	-	-	1	-	-	1
CO2	-	3	1	2	2	-	-	1	-	-	1
CO3	2	1	3	-	1	-	-	1	-	-	-
CO4	-	-	2	3	3	-	-	1	-	-	-
CO5	3	2	1	1	-	-	-	1	-	-	1

Course Name: Renewable Energy and Sustainable Development
Course Code: EE(EC)605D
Contact:3:0:0
Total Contact Hours:36
Credit:3

Prerequisite:**Renewable Energy and Sustainable Development**

CourseOutcomes:
CO1:Explain the importance of Renewable energy over conventional process
CO2: Describe different methods of Power generation from the Non- conventional sources likeSolar, Wind Energy, Biomass, Geothermal energy, OTEC, Tidal energy, MHD Power generation schemes.
CO3:Analyze the different techniques of grid integration of the power generated from renewable energy sources with the initiation of powerelectronicconvertersanddrives.
CO4:Design different hybrid energy systems and energy storage systems.

Course Content
Module1: [2L]
Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development&economic growth; strategy for meeting the future energy requirements, Global and National scenarios, Prospects of renewable energy sources. Impact of renewable energy generation on the environment, KyotoProtocol.

Module2: [9L]
SOLAR ENERGY: Solar radiation - beam and diffuse radiation, solar constant, earth sun angles,attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise,sunsetand day length. SOLARTHERMALCOLLECTORS&HEATING:Flatplate collectors,Concentratingcollectors, Solar airheaters-types, storage of solar energy-thermal storage, solar water heaters,solardistillation, solarcooker, solarheating& cooling of buildings. SOLARPHOTOVOLTAICSYSTEMS: Theory of solar cells,different types of PVCells,Monopoly Crystalline and amorphous Silicon solarcells.Conceptofmodule,array.Classification of PV systems,Advantages and disadvantages. Efficiency and cost of PV systems&its applications.

Module3: [5L]
Principle of wind energy conversion;Basiccomponentsofwindenergyconversionsystems;wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind millblades and estimation of power output from wind turbine; wind data and importance of site selection, characteristics of different types of wind, generators used with wind turbines. Merits &demerits.

Module 4: [2L]
HYDELENERGY Electricity generation from micro hydelplants,location,auxiliariesandassociatedproblems.Advantages&disadvantages.

Module5: [6L] BIOMASS ENERGY Characteristics and Properties of Biomass,Structural components of Biomass,Biomass conversion technol ogies-Biomassconversionroutes,BiochemicalandThermo–chemicalroutes, Industrial Biogas generation plants- Transformation of Biomass to Biogas,classification,advantagesanddisadvantages,constructionaldetails,siteselection,digesterdesign consideration, filling a digester for starting, maintaining biogas production, Fuel properties of biogas,utilization of biogas, Biodiesel.

Module 6: [2L]
Geo thermal energy Estimation and nature of other malenergy,geothermalsourcesandresourceslikehydrothermal, geopressured hot dry rock, magma. Advantages, disadvantages and application of geothermalenergy, prospects of geothermalenergy in India.

Module 7: [2L]
ENERGY FROMOCEAN Ocean Thermal Electric Conversion (OTEC)systems like opencycle, closed cycle,Hybrid cycle,prospects of OTEC in India.Ocean Energy frontiers single,single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.

Module 8: 2L
Magneto hydrodynamic Power generation: problems and Classification of MHD system gas conductivity problems and developments,gas conductivity,materials for MHD generators and future prospects.

Module9: 2L
HYDROGEN ENERGY: Introduction,HydrogenProductionmethods,Hydrogenstorage,hydrogen transportation,utilization of hydrogen gas,hydrogen asalternativefuelfor vehicles.

Module10: [2L]
FUELCELL: Introduction, principle of operation of fuel cell. Types of fuel cells, efficiency of fuel cell,applicationoffuelcells, limitations.

Module11: [2L]
HYBRID SYSTEMS: Introductiontohybridsystems,Need for Hybrid Systems,Different types of HybridsystemslikeDieselPV,Wind-PV,Microhydel-PV, Biomass-Dieselsystems.

TextBooks: 1. NonConventionalEnergyResources,ShobhNathSingh,PEARSON.
2. NonConventionalEnergyResourcesbySHasanSaeed,DKSharma,S.k.Kataria&Sons
3. NONCONVENTIONALRESOURCESOFENERGY,G.S.SAWHNEY,EasternEconomyEdition
4. NonConventionalEnergyResources,B.HKhan,McGrawHill Education(Chennai)

ReferenceBooks: 1. NonConventionalEnergyResources,N.K.Bansal,Vikas.
2. NonConventionalEnergyResourcesAndUtilisation.ErR.KRajput,SChandPublishers.
3.RaiG.D.,“Non– ConventionalEnergySources”,KhannaPublishers, 1993.
4.RaiG.D.,“SolarEnergyUtilisation”,KhannaPublishers, 1993.

CO-PO-PSO Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	1	-	2	-	-	2	2	2
CO2	3	2	2	1	2	3	-	-	2	1	2
CO3	3	2	1	3	-	3	1	-	1	1	1
CO4	2	2	1	1	-	3	1	-	1	1	1

Course Name: Research Methodology and Intellectual Property Right (IPR)
Course Code: HU602
Contact (Periods/Week): 1:0:0
Credit Point: 1
No. of Lectures: 12

Course Objective(s):

- To introduce the fundamentals of research methodology and techniques for identifying research problems.
- To provide awareness on literature review and ethical conduct in research.
- To develop understanding of intellectual property rights (IPR) and its implications in academia and industry.

Course Outcome(s):
After completion of the course, students will be able to:

CO1: Define and formulate a research problem.
CO2: Perform a basic literature review and identify research gaps.
CO3: Demonstrate awareness of ethical practices in research and publication.
CO4: Understand the importance of IPR in safeguarding innovations.

CO-PO-PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	-	-	-	-	2	-
CO2	3	2	2	-	-	-	-	-	-	2	-
CO3	2	-	-	-	-	3	3	2	-	2	-
CO4	2	-	-	-	-	2	3	2	-	2	-

Course Contents:

Module I: Introduction to Research Methodology [2L]

Definition, objectives, and significance of research; types of research; steps in research process; formulating research problem; importance of literature review; primary and secondary sources; identifying research gaps.

Module II: Research Ethics and Integrity [2L]

Research misconduct (Falsification, Fabrication, Plagiarism); conflict of interest; predatory journals; ethical publishing practices; citation practices; tools for plagiarism detection.

Module III: Basics of Report Writing [2L]

Structure of a research report; academic referencing; bibliography; abstracting and summarizing techniques.

Module IV: Intellectual Property Rights [6L]

Introduction to IPR: patents, copyrights, trademarks, GI. Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Legal requirements for patents — Granting of patent. Patent application process: Searching a patent- Drawing of a patent- Filing of a patent- Types of patent applications- Patent document: specification and Claims. Govt. Schemes of IPR

Trademarks- Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks.

Copyrights Right and protection covered by copyright - Law of copy rights: Fundamental of copyright law. Originality of material, rights of reproduction, rights to perform the worth publicly, copy right ownership issues, obtaining copy right registration.

Geographical Indication of Goods, GI Protection.

Textbooks:

- C. R. Kothari – Research Methodology: Methods and Techniques, New Age International.
- Catherine J. Holland – Intellectual Property: Patents, Trademarks, Copyrights, Trade Secrets, Entrepreneur Press, 2007.

Reference Books:

- The Institute of Company Secretaries of India – Professional Programme: Intellectual Property Rights, Law and Practice, Sept 2013.
- Miro Todorovich, Paul Kurtz, Sidney Hook – The Ethics of Teaching and Scientific Research.

Course Name: VLSI Design Lab
Course Code: EC691
Contact: (L:T:P) : 0:0:3
Credit: 1.5

Prerequisites: Basic Concepts of Digital and Analog Electronics

Course Outcomes (COs): After the completion of the course students will be able to

CO1:*Analyze* the DC, transient, and supply current responses of a CMOS inverter for varying process parameters (e.g., different values of Kn/Kp).
CO2:*Design and simulate* combinational logic circuits such as CMOS half adder and full adder and *verify* input-output waveforms.
CO3:*Design and simulate* sequential logic circuits such as CMOS SR lacth, flipflop and D-flipflop and *verify* input-output waveforms.
CO4:*Simulate* analog CMOS circuits such as single-stage amplifier and differential amplifier to *obtain* transfer and frequency characteristics.
CO5:*Use* SPICE tools for CMOS layout design and *validate* circuit functionality through waveform outputs.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	3	–	–	–	2	1	2
CO2	3	3	2	3	3	–	–	–	1	1	2
CO3	3	3	3	2	3	–	–	–	2	2	2
CO4	3	3	2	3	3	–	–	–	2	1	2

CO5	3	2	3	2	3	–	–	–	1	1	2

Experiment List

1. Simulation of CMOS inverter to plot voltage transfer characteristics (VTC) for different values of kn/kp ratio using SPICE tools.
   a. Measurement of critical voltages VIL, VIH, VOL, VOH from VTC.
   b. Calculation of noise margin from critical voltages.

Functional verification, measurement of gate delay and average power consumption of CMOS inverter circuit using SPICE tools.

Functional verification, measurement of gate delay and average power consumption of CMOS NAND/AND, NOR/OR gate using SPICE tools.

Functional verification, measurement of gate delay and average power consumption of CMOS XOR/XNOR gate using SPICE tools.

Design and testing of functionality of CMOS half/full adder at schematic level using SPICE tools.

Design and examination of functionality of CMOS SR latch & clocked SR latch at schematic level using SPICE tools.

Design and examination of functionality of CMOS D flip-flop at schematic level using SPICE tools.

Design of common source amplifier using MOSFET at schematic level using SPICE tools.

Design of CMOS differential amplifier with active load and current mirror bias at schematic level for given specifications using SPICE tools.

Layout design and functional verification of CMOS inverter using layout design tools of SPICE based on design rules.

Innovative experiment.

Textbooks:

1. CMOS Circuit Design, Layout and Simulation - R.J.Baker, H.W. Li and D.E. Boyce, PHI
2. Sung –Mo Kang & Yusuf Lablebici, “CMOS Digital Integrated Circuits, Analysis & Design”, Tata McGraw-Hill.

Course Name: Computer Network Lab
Course Code: EC692
Contacts: 0:0:3
Credits: 1.5

Course Objectives: This course aims to provide practical knowledge of computer networking through simulation and configuration of protocols across various network layers. It also introduces basic network security techniques such as encryption and firewall setup.

Course Outcomes:

Graduates of the ECE program will be able to:
CO1: Understand basic networking commands and utilities.
CO2: Implement and simulate link layer protocols with error control.
CO3: Configure and simulate network layer addressing, routing, and congestion control mechanisms.
CO4: Demonstrate cryptographic techniques for network security.

List of Experiments:

1. Study of networking commands: ipconfig, ping, tracert, netstat, arp, nslookup.
2. Implementation of Stop-and-Wait ARQ , Go-Back-N and Selective Repeat ARQ protocols.
3. Simulation of error detection techniques: CRC and checksum.
4. Simulation of MAC protocols: ALOHA, Slotted ALOHA, CSMA/CD.
5. Study of router and switch configuration using Cisco Packet Tracer or GNS3.
6. IP addressing and subnetting practice with simulations.
7. Implementation of Dijkstra's shortest path routing algorithm.
8. Simulation of congestion control algorithms: Leaky Bucket and Token Bucket.
9. Implementation of DES/AES symmetric key encryption.
10. Implementation of RSA public key encryption.
11. Simulation of basic firewall configuration and rule setting.
12. Innovative experiment on computer networking.

Textbooks:

1. B.A. Forouzan – Data Communications and Networking (3rd Ed.) – TMH
2. A.S. Tanenbaum – Computer Networks (4th Ed.) – Pearson/PHI
3. William Stallings – Data and Computer Communications (5th Ed.) – Pearson

Reference Books:

1. Kurose and Ross – Computer Networking: A Top-Down Approach – Pearson
2. Leon-Garcia &Widjaja – Communication Networks – TMH
3. Warwick Ford, Michael S. Baum – Secure Electronic Commerce – Prentice Hall

CO-PO-PSO Mapping:

CO \PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11
CO1	3	2	–	–	2	–	–	–	–	1	–
CO2	3	3	3	2	3	–	–	–	–	1	–
CO3	3	3	3	3	3	–	–	–	–	2	–
CO4	3	2	2	–	2	2	2	2	–	1	–

Course Name: Introduction to IoT lab
Course Code: EC693A
Contact: 0:0:3
Credit: 1.5

Prerequisites: Sensors, Actuators, Microcontroller, Computer Networks

Course Objectives: The purpose of this course is to gather knowledge about IoT, its architecture different software and hardware components of IoT. Finally students will apply such knowledge to design some hands-on models showcasing different IoT applications.

Course Outcomes: After this course students will be able to
CO1: Understand Arduino and Raspberry pi with its hardware and software components.
CO2: Apply interface I/O devices, sensors, actuators and communication modules in ESP32 or ESP8266 Board through Arduino IOT Cloud.
CO3: Analyze remotely monitor data and control devices through Wireshark capture and Blynk IOT Console.
CO4: Create real life IoT based innovative projects.

Lab Experiments:
1. Familiarize with Arduino and Raspberry pi with necessary installations
2. Interface LED with ESP32 or ESP8266 Board through Arduino IOT Cloud.
3. Design of Traffic Management system with Arduino and Raspberry pi
4. Interface DHT11/22 (Temperature and humidity) Sensor with ESP32 or ESP8266 Board through Arduino IOT Cloud.
5. Interface and control DC Motor with ESP32 or ESP8266 Board through Arduino IOT Cloud.
6. Interface MQ-05 (LPG) Sensor with ESP32 or ESP8266 Board through Arduino IOT
7. Find machine IP address and packets sent using Wireshark capture
8. Implement MQTT protocol installing Node.js and Node-RED
9. Install Blynk App in mobile and control LED on /off remotely by mobile button
10. Interface Ultrasonic Sensor with ESP32 or ESP8266 Board through Blynk IOT Console.
11. Set up an experiment for Think Speak based DHT Sensor Monitoring

12. Any other innovative experiments

Books

1. 21 IoTExperements,YashavantKanetakr,ShrirangKorde, BPB
2. IoT based Projects: Realization with Raspberry Pi, NodeMCU, Rajesh Singh Anita Gehlot, BPB

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	-	-	-	-	-	2
CO2	2	1	3	3	1	-	-	-	2	-	2
CO3	2	3	2	3	2	-	-	-	1	-	2
CO4	2	1	3	3	1	-	-	-	2	-	2

Subject Name: Digital Image Processing Lab
Code: EC693B
Contact hour: 0:0:3
Credits:1.5

Course Outcome:

Graduates of the ECE program will be able to:
CO1: Build knowledge on Digital Imaging fundamentals and Digital Image Transform. CO2: Understanding Digital Image enhancement techniques in spatial and frequency domain.

CO3: Explain in the requirements and types of Image Compression and its standards.
CO4: Demonstrate the Segmentation and Edge detection techniques of Digital Images
CO5: Build ideas on Digital Image security and Basic Steps of Video Processing

List of Experiments:

1. Convert RGB Digital Images into Grayscale Images and show result.
2. Transform a grayscale image into frequency domain and show its magnitude and phase angle.
3. Display histogram of a digital image and equalized the image.
4. Apply LPF and HPF in a Grayscale Digital Image and display result.
5. Apply Mean and Median filtering in a Grayscale Digital Image and display result.
6. Compress and reconstruct a Grayscale Digital Images in spatial domain.
7. Compress and reconstruct a Grayscale Digital Image in frequency domain.
8. Apply segmentation technique (anyone) in a Digital Image and display result.
9. Apply Edge detection technique in a Digital Image and display result.

10. Apply any cryptography or watermarking technique for image encryption and display result.
11. Experiment of division of a video into frames
12. Experiment on Frequency domain motion estimation
13. Experiment on Kernel based tracking
14. Experiment on video short boundary detection
15. Innovative experiment

Textbooks:

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2010.
2. S. Annadurai,R. Shanmugalakshmi, “Fundamentals of Digital Image Processing”, Pearson Education, 2006
3. Yao wang, JoemOstarmann and Ya–quin Zhang,“Video processing and communication”,,PHI

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO10	PO11
CO1	3	-	1	-	-	2	-	2	-	-	-
CO2	-	3	-	2	-	1	-	-	2	-	-
CO3	2	-	1	-	1	-	3	-	-	2	-
CO4	3	-	1	-	-	-	2	1	-	-	-
CO5	2	-	2	-	-	3	1	-	-	2	-

Course Name: Drone Technology Lab
Course Code: EC693C
Semester: 6th
Year: 3rd Year
Credits: 1.5

Course Outcomes (CO):

CO No	Course Outcome Description
CO1:	Identify and assemble essential drone components with proper wiring and hardware integration.
CO2:	Perform basic drone flight simulations using industry-standard tools like Mission Planner.
CO3:.	Acquire, calibrate, and interpret data from onboard sensors such as IMU, GPS, and barometer.
CO4:	Develop and implement basic flight control algorithms using DroneKit.
CO5:	Establish and test communication links using telemetry and RF modules for drone operations.

CO-PO mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	1	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-
CO3	-	1	1	1	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-
CO5	1	1	-	-	1	-	-	-	-	-	-

Experiments:

1. Drone components identification, wiring, and hardware assembly
2. Basic drone flight simulation using software tools (Mission Planner)
3. Sensor data acquisition and calibration (IMU, GPS, Barometer)
4. Programming basic flight controls using Drone Kit
5. Communication link testing: telemetry and RF modules
6. Sensor fusion basics: integrating IMU and GPS data
7. Autonomous waypoint navigation simulation and mission planning
8. Fault diagnosis and troubleshooting of drone hardware and software
9. Mini project: Implementing simple obstacle avoidance using sensors

Paper Name: Advanced communication Lab
Paper Code: EC693D
Contact hours: 0-0-3
Credits: 1.5

Program Objectives:

- To introduce the basic principles, methods, and applications of various advanced communication systems.
- To learn measurement and synchronization with ambient changes.

Course Outcomes:

CO1: Analyze and interpret digital modulation schemes such as QPSK by evaluating parameters like signal bandwidth, noise impact, and distinguishability of signals.

CO2: Demonstrate sampling, quantization, and coding techniques by measuring sampling rate effects, quantization errors, and signal bandwidth to assess signal fidelity and efficiency.

CO3: Implement and evaluate synchronization and error control techniques, including bit synchronization and error correction coding, to ensure reliable digital communication.

CO4: Design and analyze data transmission systems using sampling and reconstruction for various signal types (e.g., external and audio signals), assessing signal integrity and reconstruction accuracy.

CO5: Apply and assess spread spectrum techniques (DSSS) by performing modulation (spreading) and demodulation (de-spreading), and evaluating their effectiveness in enhancing communication robustness and security.

Experiments:

1. QPSK – signal bandwidth, distinguish ability, effect of noise etc.
2. Sampling, quantization, coding – sampling rate, quantization error, signal bandwidth etc.
3. Bit synchronization technique
4. Error control coding techniques
5. Sampling and reconstruction data transmission scheme for
   a. External sampling signal
   b. Audio signal
6. Modulation (Spreading) of DSSS signal.
7. De-modulation (De-spreading) of DSSS signal.

CO-PO Mapping:

CO\PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2								3	2	
CO2	2	2	2	2	3					2		3	3	2
CO3	3	3	2	3	2					2		3	2	2
CO4	3	2	2	2	2							2	2	3
CO5	3	2	3	3	3					2		3	3	3

Subject Name: Adaptive Signal Processing Laboratory
Paper Code: EC694A
Semester: 6th
Credits: 1.5

CO No.	Course Outcome(After the completion of the course , students will be able to)
CO1	Implement and simulate adaptive algorithms (LMS, RLS, etc.) using MATLAB or Python.
CO2	Analyze convergence and misadjustment properties of adaptive filters.
CO3	Apply adaptive filters to real-life problems such as noise cancellation and echo suppression.
CO4	Compare LMS and RLS algorithms in terms of speed, accuracy, and complexity.
CO5	Develop innovative solutions using adaptive filtering principles for modern signal processing issues.

COs → POs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	3	3	-	-	-	-	2	-
CO2	2	3	3	2	3	-	-	-	-	2	-
CO3	2	2	3	2	3	-	-	-	-	2	-
CO4	2	2	3	2	3	-	-	-	-	1	-
CO5	3	3	3	3	3	-	-	-	1	2	-

Exp. No.	Experiment Title
1	Generation of white Gaussian noise and study of its statistical properties
2	Implementation of Wiener filter using MATLAB for noise reduction
3	Design and simulation of LMS algorithm for system identification
4	Analyze convergence behavior of LMS with different step sizes
5	Implementation of Normalized LMS (NLMS) algorithm
6	Design and simulation of RLS algorithm for adaptive filtering
7	Performance comparison between LMS and RLS in terms of convergence and error
8	Adaptive noise cancellation using LMS algorithm
9	Channel equalization using adaptive filters (LMS or RLS)
10	Adaptive echo cancellation in speech signal processing
11	Real-time signal prediction using LMS filter (predict future samples of a signal)
12	**Innovative Experiment** – Design an Adaptive Filter for EEG signal enhancement (denoising brain signal data)

Course Name: Automotive Electronics Lab
Course Code: EC694B
Contacts: 0:0:3
Credit: 1.5

Course Outcomes:
After completing the course, the student will be able to:
CO1: Understand the architecture of automotive electronic systems and their functional elements.
CO2: Identify and analyze various automotive sensors and actuators used in electronic control units.
CO3: Explain the functioning of engine management and emission control systems.
CO4: Evaluate safety and comfort electronic systems in vehicles.
CO5: Apply in-vehicle networking and diagnostic protocols in automotive applications.

List of Experiments:
1. Study and identification of automotive sensors (temperature, oxygen, MAP, throttle, knock, speed).
2. Hands-on analysis of actuators: injectors, solenoids, stepper and DC motors.
3. Interfacing temperature or throttle sensors with Arduino/8051 and reading analog/digital values.
4. Design and simulation of an engine ignition control system using Proteus or MATLAB.
5. Implementation of electronic fuel injection logic using microcontroller and sensor feedback.
6. Simulate and analyze ABS (Anti-lock Braking System) or airbag system in a test environment.
7. Communication between two microcontroller nodes using CAN protocol (demonstration).
8. Design a simple HVAC control system with sensor inputs and actuation logic.
9. Display vehicle parameters (RPM, speed, temperature) on LCD/LED interface via microcontroller.
10. Mini Project: Real-time prototype of an automotive feature such as smart lighting, obstacle detection, or keyless system.

Text/Reference Books:

- William B. Ribbens, *Understanding Automotive Electronics*, 7th Edition, Butterworth-Heinemann.
- Robert Bosch GmbH, *Automotive Handbook*, 9th Edition.
- Tom Denton, *Automobile Electrical and Electronic Systems*, 4th Edition, Routledge.
- K.K. Jain and R.B. Asthana, *Automobile Electrical Equipment*, Tata McGraw Hill.
- James D. Halderman, *Automotive Electricity and Electronics*, Pearson.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	-	-	-	-	1	1	1
CO2	3	2	2	2	1	-	-	-	2	1	1
CO3	3	2	2	2	1	-	-	-	2	1	1
CO4	3	2	2	2	1	-	-	-	2	1	1
CO5	2	2	3	2	1	1	1	-	2	1	1

Subject: Industrial Automation and Robotics Laboratory
Paper Code: EC694C
Program: B.Tech in Electronics and Communication Engineering
Credits: 1.5
Total Lab Hours: 24 (2 hours/week × 12 weeks)
Semester: 6th

Prerequisites: Knowledge of sensors, microcontrollers, and basic control systems

CO No.	Course Outcome(After the completion of the course, students will be able to)
CO1	Understand and operate various components used in industrial automation systems.
CO2	Develop and simulate PLC ladder logic programs for industrial tasks.
CO3	Interface sensors and actuators with microcontrollers/PLCs.
CO4	Program and control a basic robotic arm for pick-and-place or similar operations.
CO5	Analyze and evaluate automation setups based on performance and application constraints.

COs ↓ / POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	1	-	-	-	-	-	-
CO2	2	3	3	2	3	-	-	-	-	1	-
CO3	2	2	2	2	3	-	-	-	-	1	-
CO4	3	3	2	3	3	-	-	-	1	2	-
CO5	2	2	3	3	3	-	-	-	2	2	-

Course Content:

Exp. No.	Title
1	Study of industrial automation components: sensors, actuators, relays, and controllers
2	Introduction to PLC: architecture and programming environment
3	Write basic ladder logic programs for logic gates and LED control
4	Design timer and counter-based control systems using PLC
5	PLC program for traffic light control system
6	Motor control using PLC (DC motor, stepper, or servo motor)
7	Interfacing proximity and temperature sensors with PLC
8	HMI (Human Machine Interface) design for simple process control
9	Study and control of a robotic arm using GUI or programming software
10	Programming pick-and-place task using a robotic manipulator

11	Simulation of an automated conveyor belt system with sorting mechanism
12	**Mini Project / Innovative Task**: Design and simulate a smart automation system (e.g., automated bottle filling, warehouse robot, or smart factory cell)

Course Name: Electronic Design Automation (EDA)
Course Code: EC694D
Contact: (L:T:P) : 0:0:3
Credit: 1.5

Prerequisites: Basic Concepts of Digital and Analog Electronics

Course Outcomes (COs):

CO1:*Demonstrate* the ability to use SPICE simulation tools for analyzing basic CMOS logic gates. → (Mapped to Lab 1 & 2) → Cognitive Level: Apply
CO2:*Use* industry-standard EDA tools for designing VLSI/FPGA-based digital circuits. → (Mapped to Lab 3) → Cognitive Level: Apply
CO3:*Design and simulate* basic and complex CMOS logic circuits such as XOR/XNOR, half adders, full adders, and flip-flops using VHDL/Verilog. → (Mapped to Lab 4, 5, 6, 7, 8) → Cognitive Level: Create / Analyze
CO4:*Develop* layout designs of CMOS gates and verify their functionality through simulation outputs. → (Mapped to Lab 9, 10, 11) → Cognitive Level: Create / Evaluate
CO5:*Interpret* simulation results and layout outputs to validate the correctness and performance of designed circuits.
→ (Mapped to Labs 1–11) → Cognitive Level: Create,Evaluate

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	3	–	–	–	2	2	1
CO2	3	2	2	1	3	–	–	–	2	1	2
CO3	3	3	3	2	3	–	–	–	2	1	2
CO4	3	2	3	2	3	–	–	–	1	1	2
CO5	3	3	2	3	3	–	–	–	2	2	2

Experiment list:

Laboratory 1. Familiarity with SPICE simulation tool.
Laboratory 2. SPICE Simulation of CMOS Inverter, NAND Gate, NOR Gates.
Laboratory 3. Familiarity with EDA tools for VLSI design /FPGA based system design
Laboratory 4. Design of Basic Gates.
Laboratory 5. Design of CMOS XOR/XNOR Gates.
Laboratory 6. Design of Half adder and obtain its input output waveforms using VHDL/Verilog.

Laboratory 7. Design of Full adder and obtain its input output waveforms using VHDL/Verilog.
Laboratory 8. Design of Flip flops (R-S, D, J-K) and obtain its input output waveforms using VHDL/Verilog.
Laboratory 9. Layout Design of CMOS Inverter and obtain its outputs
Laboratory 10. Layout Design of CMOS NAND gate and obtain its outputs.
Laboratory 11. Design of Sequence Detector/ Traffic Light Controller using VHDL/Verilog.

Reference

1. M.J.S Smith , Application Specific Integrated circuits ,Pearson.
2. P.J Anderson ,The designer's guide to VHDL, Morgan Kaufman , 2nd edition ,2002.
3. W.Wolf , Modern VLSI Design: Systems on silicon , Pearson
4. G.Hatchel and F.Somenzi , logic Synthesis and verification Algorithms,Kluwer,1998
5. http://www-ee.eng.hawaii.edu/~msmith/ASIC/HTML/ASIC.htm#anchor935203
6. J.Bhasker ,A VHDL Primer , BS Publications/Pearson Education

Course Name: Project-1
Course Code: EC681
Credit: 4

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work.
The assignment to normally include:
1. Survey and study of published literature on the assigned topic
2. Working out a preliminary Approach to the Problem relating to the assigned topic
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility
4. Preparing a Written Report on the Study conducted for presentation to the Department
5. Final Seminar, as oral Presentation before a departmental committee.

4th Year 7th Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	EC701	Embedded Systems	3	0	0	3	3
2	ENGG	Major	EC702A	IC Technology	3	0	0	3	3
			EC702B	Fiber Optic Communication					
			EC702C	Electric Vehicle Technology					
			EC702D	Introduction to AR/VR					
3	ENGG	Minor	CS(EC)701 A	Data Analytics and Security in IoT	3	0	0	3	3
			CS(EC)701 B	Deep Learning					
			CS(EC)701C	Cyber Security & Cryptography					
			CS(EC)701D	Blockchain Technology					
4	HUM	Skill Enhancem Ent Course	HU(EC)701	Project Management and Finance	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	EC791	Embedded Systems Lab	0	0	3	3	1.5
3	ENGG	Skill Enhancement Course	PR792	Rapid Prototyping Lab	0	0	3	3	1.5
4	PRJ	Project	EC782	Project-II	0	0	0	12	6
Total of Theory, Practical								**29**	**20**

Subject Name: Embedded System Subject code: EC 701

Credit: 3

Total Contacts: 36

Prerequisite:

(1) Concepts in 8085 ,8086 Microprocessor

(2) Concept of MCS51 series of Microcontroller.

Course Objectives:

- To familiarize the students with concepts related to the fundamental principles embedded systems design, explain the process and apply it.
- To understand knowledge of the advanced microcontroller technology both for hardware and software.
- Students will be able to understand Hardware/Software design techniques for microcontroller-based embedded systems and apply techniques in design problems.
- Students will be able to develop microcontrollers programming in C and assembly language using Integrated Development Environments and using debugging techniques.

Course Outcomes (COs)

Graduates of the ECE program will be able to:

- **CO1: To differentiate between general purpose system and embedded systems.**
- **CO2: To explain the hardware architecture, timing diagrams, interfacing, interrupts, data communication of PIC microcontrollers.**
- **CO3: To demonstrate the hardware architecture, RISC Instruction set, timing diagrams, interfacing, interrupts, data communication of ARM processors.**
- **CO4: To design customized embedded systems.**

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	2	-	-	-	-	-	1
CO2	3	2	2	3	3	-	-	2	3	1	2
CO3	3	2	2	3	3	-	-	2	3	1	2
CO4	3	3	3	3	3	3	2	3	3	3	3

Module I: INTRODUCTION TO EMBEDDED SYSTEM: [3]

Basics of Embedded computer Systems, Microprocessor and Microcontroller difference, Hardware architecture and software components of embedded system, Difference between embedded computer systems and general-purpose computer Systems. Characteristics of embedded systems, Classifications of embedded systems.

Module II: ARM ARCHITECTURE AND PROGRAMMING: [10]

Introduction of ARM Processors, Evolution of ARM, 32 - bit Programming. ARM7 Architecture, Instruction Set Architecture, LPC21xx Description, Memories & Peripherals. ARM Processor

Programming in C, Using ARM Programming Tools.

Module III: INTRODUCTION TO PIC MICROCONTROLLER: [9]

PIC 18F4550 Microcontroller – Hardware Architecture & GPIOs ((Pin Diagram, Memory Organization, SFRs description, Program Counter, Accumulator (or Working Register), Reset, Clock Cycle, Machine Cycle, Instruction Cycle, Interrupts, SFRs & GPRs, Stack, Stack Pointer, Stack Operation, Timers and serial communication in PIC 16F877A). Microcontroller PIC Assembly Language, Programming in Embedded C, Introduction to programming software, Examples programs for PIC. I2C, SPI Protocol, Serial Memory, On chip Peripherals PWM.

Module IV: HARDWARE SOFTWARE CO- DESIGN: [7]

Hybrid Design. Methodology: i) System specifications ii) co-specifications of hardware and software iii) System Design Languages (capturing the specification in a single Description) iv) System modeling /simulation v) Partitioning (optimizing hardware/software partition) vi) Co-verification (simulation interaction between custom hardware and processor) vii) Co-implementation. Co-Design Types: Microprocessors/Microcontrollers/DSP based Design, Embedded Systems Design development cycle. Programming concepts and embedded programming in C.

Module V: INTERFACING: [4]

Communication basics (Basic terminology, Basic protocol concepts), Microprocessor interfacing (IO port Interfacing, Interrupt & DMA), Arbitration (Priority arbiter, Daisy-chain arbitration, Networked-oriented arbitration methods), Multi-level bus architectures, Parallel Communication, Serial Communication & Wireless Communication, Serial Protocols (I2C bus, CAN bus, FireWire bus, USB), Parallel protocols (PCI bus, ARM bus), Wireless protocols (IrDA, Bluetooth, IEEE 802.11)

MODULE VI: REAL TIME OPERATING SYSTEM (RTOS): [3]

Introduction, Types, Process Management, Memory Management, Interrupt in RTOS, Task scheduling, Basic design using RTOS; Basic idea of Hardware and Software testing in Embedded Systems, Examples of RTOS: FreeRTOS, VxWorks.

Textbooks:

1. Steve Furber, 'ARM system on chip architecture', Addision Wesley
2. PIC Microcontroller – Mazidi and Mazidi
3. K. Shibu, "Introduction to Embedded Systems", TMH
4. Frank Vahid and Tony Givargis, 'Embedded System Design: A Unified Hardware/Software Introduction', John Wiley & Sons
5. Embedded system Design: Peter Marwedel, Springer
6. Embedded Systems - Raj Kamal

Reference books:

1. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2007.
2. ARM Architecture Reference Manual
3. Microchip's PIC microcontroller is rapidly becoming the microcontroller of choice throughout the world, Myke Predco

Course Name: IC Technology
Course Code: EC702A
Contacts:3-0-0
TotalContacts:36
Credits: 3

Course Pre-Requisites:
Electronic Devices, Digital Circuits and Design, Discrete electronics circuits, Design with Linear & Integrated circuits, Basic VLSI design

Course Objectives:
1. To teach fundamental principles of fabrication of VLSI devices and circuits
2. To disseminate knowledge about novel VLSI devices

Course Outcome: After successful completion of the course student will be able to
CO1. Demonstrate a clear understanding of CMOS fabrication flow and technology scaling
CO2. Demonstrate a clear understanding of various MOS fabrication processes, semiconductor measurements, packaging, testing and advanced semiconductor technologies
CO3. Discuss physical mechanism in novel devices
CO4. Verify processes and device characteristics via simulations.

CO-PO mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1
CO1	3	2	-	-	-	-	-	-	-	3	-
CO2	3	3	3	3	3	-	2	-	-	3	-
CO3	3	1	3	1	-	-	-	-	-	2	-
CO4	3	1	-	3	3	-	-	-	3	-	-

Module 01: Environment and Crystal Growth for VLSI Technology [6]
Environment: Semiconductor technology trend, Clean rooms, Wafer cleaning Semiconductor Substrate: Phase diagram and solid solubility, Crystal structure, Crystal defects, Czochralski growth, Bridgman growth of GaAs, Float Zone growth, Wafer Preparation and specifications

Module 02: Fabrication Processes Part 1 [10]
Epitaxy: Molecular Beam Epitaxy, Vapor Phase Epitaxy, Liquid Phase Epitaxy, Evaluation of epitaxial layers Silicon Oxidation: Thermal oxidation process, Kinetics of growth, Properties of Silicon Dioxide, Oxide Quality, high κ and low κ dielectrics Deposition: Evaporation, Sputtering and Chemical Vapor Deposition. Lithography: Photo reactive materials, Pattern generation and mask making, pattern transfer, Electron beam, Ion beam and X-ray lithography. Etching: Wet chemical etching, dry physical etching, dry chemical etching, reactive ion etching, ion beam techniques.

Module 03: Fabrication Processes Part 2 [7]
Diffusion: Nature of diffusion, Diffusion in a concentration gradient, diffusion equation, impurity behavior, diffusion systems, problems in diffusion, evaluation of diffused layers Ion Implantation: Penetration range, ion implantation systems, process considerations, implantation damage and annealing. Device Isolation, Contacts and Metallization: Junction and oxide isolation, LOCOS, trench isolation, Schottky contacts, Ohmic contacts, Metallization and Packaging

Module 04: Measurements, Packaging and Testing [6]
Semiconductor Measurements: Conductivity type, Resistivity, Hall Effect Measurements, Drift Mobility,

Minority Carrier Lifetime and diffusion length Packaging: Integrated circuit packages, Electronics package reliability Testing: Technology trends affecting testing, VLSI testing process and test equipment, test economic sand product quality

Module 05: SOI, GaAs and Bipolar Technologies [7]
SOI Technology: SOI fabrication using SIMOX, Bonded SOI and Smart Cut, PD SOI and FD SOIDevice structure and their features GaAs Technologies: MESFET Technology, Digital Technologies, MMIC technologies, MODFET and Optoelectronic Devices Case study:(Optional) Resistance Estimation, Capacitance Estimation, Gate delay modelling, CMOS-gate transistor sizing, Power Dissipation calculation

TEXTBOOKS:

1. S.M.Sze(2nd Edition)"VLSI Technology", McGraw Hill Companies Inc.
2. C.Y. Chang and S.M.Sze (Ed), "ULSI Technology", McGraw Hill Companies Inc.
3. VLSI Design Techniques for Analog and Digital Circuits R. L. Geiger, P.E. Allen, and N. R. Strader
4. S.Franssila Introduction to Microfabrication Wiley 2010 (2nd ed.) ISBN 978-0-470-74983-8
5. Sunipa Roy, Chandan Kumar Ghosh, Sayan Dey, Abhijit Kumar Pal, Solid State & Microelectronics Technology, ISBN: 978-981-5079-88-3 (Print), Bentham science publishers, 1stedition. June 2023.

REFERENCES:

1.Stephena, Campbell, "The Science and Engineering of Microelectronic Fabrication", Second Edition, Oxford University Press.
2.James D.Plummer, Michael D.Deal, "Silicon VLSI Technology" Pearson Education
3. Richard C. Jaeger, Introduction to Microelectronic Fabrication, Prentice Hall, 2002. (2nd ed.) ISBN0-201-44494-1.
4. Gary S. May, Simon M. Sze, Fundamentals of Semiconductor Fabrication, Wiley, 2004.
5. Sunipa Roy, Chandan Kumar Sarkar, MEMS and Nanotechnology for Gas Sensors, CRC Press,USA, 1st edition. 2017, ISBN: 9781315214351

Fiber Optic Communication
Code: EC702B
Contacts:3-0-0
Total Contact hours: 36
Credits: 3

Prerequisite: Concept of Ray theory, electromagnetic wave theory and communication engineering.
Course Outcome: After the successful completion of the course the students will be able to:
CO1: Analyze basic concept of Optical fiber communication and ray theory concept.
CO2: Illustrate Types of fibers and Wave guides fundamentals.
CO3: Demonstrate the principle and operation of the optical sources and detectors such as LASER &amplifiers; APD and optical connectors.
CO4: Generalise SONET/SDH and architecture of Optical Transport Network. CO5:Discuss the elements of WDM networks and its potential applications.
Course Content:
Module I: Introduction to Fiber Optics communication system and properties of Ray theory transmission: 4L
Concepts of Analog and Digital Optical Fiber link , Advantages of Optical Fiber Communication, Cladding and Core concept of Optical Fiber waveguides, Total Internal reflection, Snell's Law, Acceptance angle, Numerical Aperture, Meridional ray, Skew ray
Module II: Optical Fiber: 8L
Materials, Types of fibers, Wave guides fundamentals: Analog and Digital Optical Transmitters and Receivers concepts: Modes in Planar Guide, Phase and Group Velocity, Mode Coupling, Step and Graded Index Fiber: Basic concept with mathematical expression(no derivation needed), Transmission characteristics: Attenuation and Dispersion mechanism and their effects. Special type Fibers, Loss-limited and dispersion- limited light wave systems, Long-haul systems with In-Line Amplifiers, Dispersion compensation techniques in optical communication systems, Power budget and rise-time.
Module III: Optical Sources and Detectors: 7L
General Principles of LASER action: Absorption and emission of radiation,Population inversion , Optical feedback and LASER Oscillation, Threshold condition for LASER oscillation, Introduction to lasers, Simple rate equation modeling of: saturation, gain, amplifiers, Examples of types of lasers: HeNe, Nd:YAG, diode, Ti:Sapphire. LEDs and ILDs : Characteristics, Drive circuits; Optical detection principle, P-N, P-I-N and APD, Photo transistor, Receiver Structure, SNR, Sensitivity. Module IV: Inter-Connecting Devices: 5L Couplers, Isolators, Polarizers, Circulators, Filters, Add/Drop Mux/Demux, Fiber Optic Repeaters and Optical Amplifiers.
Module V: Communication System and Optical Network: 12L
System design issues, Link analysis, Intensity modulation/direct detection system. Digital systems: coding and multiplexing mechanism, Coherent light wave systems: Modulation and Demodulation scheme for coherent communication, System performance issues, Multichannel Light wave systems: WDM components and devices, Multiplexing techniques and system performance issues. Optical Networks: Network topologies, SONET/SDH, Broadcast-and-Select WDM Networks-single-hop networks, multihop Networks, Wavelength routed networks.

Textbooks: 1. Optical Networks –Rajiv Ramaswami, K. N. Sivarajan, Galen H. Sasaki (Morgan-Kaufman)
2.Optical Fibre Communication : John M. Senior (Pearson)

3.Optical Communications: N. Bala Saraswathi, I. Ravi Kumar (LaxmiPublications)

Reference Books 1.Optical Communication Systems: John Gawar (PHI)

2.Optical Fibre Communication: Gerd Kaiser (TMH)

3. Fiber optics communication by G.P Agrawal.

4. Raman Amplifiers for communications by M.N. Islam(Ed).

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	3	2	1	-	-	2	3	1	2	2
CO2	3	3	1	2	2	-	-	3	3	2	-
CO3	3	3	3	2	2	-	-	-	-	-	-
CO4	2	2	3	2	3	-	3	2	3	-	-
CO5	3	2	3	3	3	-	3	3	3	-	-

Subject Title: Electric Vehicle Technology
Subject Code: EC702C
Semester: 7th
L–T–P: 3–0–0
Credits: 3
Total Contact Hours: 36

Course Objectives:

1. To build a solid foundation in electric vehicle systems for students of diverse learning capabilities.
2. To provide a step-by-step understanding of EV architecture, drive systems, and component functions.
3. To introduce propulsion motors, battery technologies, and energy management basics.
4. To provide basic knowledge of charging systems, energy storage, and control in EVs.
5. To promote advanced understanding of EV control, communication protocols, and smart grid integration.
6. To prepare students for future research and industry roles in sustainable electric mobility.

Module No.	Topic	Sub-Topic	Contact Hours
1	Fundamentals of Electric Vehicles	Introduction to EVs: history, need for electric mobility; environmental impact; global and national EV scenarios; EV vs ICE: powertrain, efficiency, emissions, cost of ownership; classification - BEV, HEV, PHEV, FCEV.	6
2	EV Subsystems and Powertrain Architecture	Study of key components: battery, motor, controller, power converter, charger, auxiliary systems; visual block diagram representation of EV architecture; simple explanation of energy flow from source to wheel.	6
3	Electric Propulsion Motors	Role of motors in EVs; operating characteristics and comparison of DC motor, BLDC, PMSM, and Induction Motors; selection criteria based on application; efficiency curves; introduction to inverter-fed drives and their effect on performance.	6
4	Battery Technology and Management Systems	Electrochemical energy storage: Li-ion, NiMH, Lead-Acid batteries; working principles, charge/discharge characteristics, degradation factors; overview of Battery Management Systems (BMS): SoC/SoH estimation, thermal control, battery swapping using digital twin, safety, and protection features.	6
5	Charging Methods and Infrastructure	Basics of charging stations, plug-in chargers; simple concepts of slow and fast charging; safety practices while charging EVs; emerging trends like wireless charging explained with examples and simplified diagrams.	6
6	EV Control & Smart Integration	Embedded control systems in EVs; role of microcontrollers, ECUs; introduction to CAN	6

		protocol; regenerative braking control strategies; fault diagnostics; smart grid integration; data acquisition, telemetry, IoT-based EV monitoring, predictive maintenance.	

Course Outcomes (COs):

CO.1 - Understand the evolution, classification, and relevance of electric vehicles.
CO.2 - Analyze the role of subsystems in EV architecture and estimate driving range.
CO.3 - Evaluate and select appropriate electric motors based on performance needs.
CO.4 - Explain battery chemistry, configuration, and effective management techniques.
CO.5 - Describe different EV charging methods and infrastructure concepts.
CO.6 - Apply control strategies and smart communication protocols in EV applications.

Text Books:

1. James Larminie and John Lowry, Electric Vehicle Technology Explained, 2nd Ed., Wiley, 2012.
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2011.
3. MehrdadEhsani, Yimin Gao, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles, CRC Press, 2005.
4. Chris Mi, M. Abul Masrur, David WenzhongGao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Wiley, 2011.

Reference Books:

1. K.T. Chau, Electric Vehicle Machines and Drives: Design, Analysis and Application, Wiley-IEEE Press, 2015.
2. Sandeep Dhameja, Electric Vehicle Battery Systems, Newnes (Elsevier), 2001.
3. S.S. Williamson (Ed.), Energy Management Strategies for Electric and Plug-in Hybrid Vehicles, Springer, 2013.
4. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.

CO–PO–PSO Mapping Matrix:

CO \ PO/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO.1	2	1	-	-	-	3	3	2	-	-	2
CO.2	3	2	2	-	1	-	-	-	-	-	2
CO.3	2	2	2	-	2	-	-	-	-	-	2
CO.4	2	2	1	-	2	1	1	-	-	-	1
CO.5	2	1	2	-	3	-	-	-	-	-	2
CO.6	2	2	1	-	2	1	2	1	-	1	2

Subject: Introduction to Augmented Reality (AR) and Virtual Reality (VR)
Code: EC702D
Contact: 3L:0T:0P
Credits: 3

Course Objectives:

1. Learn the fundamental Computer Vision, Computer Graphics and Human-Computer interaction Techniques related to VR/AR
2. Review the Geometric Modeling Techniques
3. Review the Virtual Environment
4. Discuss and Examine VR/AR Technologies

Course Outcomes: On completion of the course the learner will be able to;

CO1.**UNDERSTAND**fundamentalComputerVision,ComputerGraphicsandHuman-ComputerInteraction Techniques related to VR/AR
CO2.**UNDERSTAND** Geometric Modeling Techniques
CO3.**UNDERSTAND** the Virtual Environment
CO4.**ANALYZE** and **EVALUATE** VR/AR Technologies

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	1	-	1	-	-	2
CO2	2	3	-	-	-	1	-	1	-	-	-
CO3	2	2	3	2	1	-	-	1	-	-	2
CO4	2	2	2	3	-	2	-	1	-	-	-

Course Contents

Introduction to Virtual Reality(VR)
VirtualRealityandVirtualEnvironment,Computergraphics,Realtimecomputergraphics,FlightSimulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark

Computer Graphics and Geometric Modeling
The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modeling, 3D clipping, Illumination models, Reflection models, Shading algorithms,GeometricalTransformations:Introduction,Framesofreference,Modelingtransformations, Instances, Picking, Flying, Scaling the VE, Collision detection

Virtual Environment
Input / Output Devices: Input (Tracker, Sensor, Digital Gloves, Movement Capture, Video-based Input, 3D Menus & 3D Scanner, etc.), Output (Visual/Auditory/Haptic Devices)
Generic VR system:
Introduction,Virtualenvironment,Computerenvironment,VRtechnology,Model of interaction, VR Systems, Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape& object in between, free from deformation, particle system.

Augmented Reality(AR)

Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating AR systems

AR/VR Applications

Introduction, Engineering, Entertainment, Science, Training, Game Development

Text Books:

1. Coiffet,P.,Burdea,G.C.,(2003),“VirtualRealityTechnology,”Wiley-IEEEPress,ISBN:9780471360896
2. Schmalstieg,D.,Höllerer,T.,(2016),“AugmentedReality:Principles&Practice,”Pearson,ISBN: 9789332578494
3. Norman,K.,Kirakowski,J.,(2018),“WileyHandbookofHumanComputerInteraction,”,Wiley-Blackwell, ISBN: 9781118976135
4. LaViolaJr.,J.J., Kruijff, E.,McMahan, R. P.,Bowman, D.A., Poupyrev, I., (2017), “3DUser Interfaces: Theory and Practice,” Pearson, ISBN: 9780134034324

   Fowler,A.,(2019),“BeginningiOSARGameDevelopment:DevelopingAugmentedRealityApps with Unity and C#,” Apress, ISBN: 9781484246672

References Books:

1. Craig,A.B.,(2013),“UnderstandingAugmentedReality,ConceptsandApplications,”Morgan Kaufmann, ISBN:9780240824086
2. Craig, A. B., Sherman, W. R., Will, J. D., (2009), “Developing Virtual Reality Applications, Foundations of Effective Design,” Morgan Kaufmann, ISBN: 9780123749437
3. JohnVince,J.,(2002),“VirtualRealitySystems,“Pearson,ISBN:9788131708446
4. An and,R.,“Augmented and Virtual Reality,”Khanna Publishing House

Subject Name: Data Analytics and Security in IoT
Code : CS(EC)701A
Credit : 3
Contact: 34 L

Course objectives (COs)

Upon successful completion of this course, students should be able to:

CO1: Understand the fundamental concepts of IoT architecture and its components.

CO2: Analyze different connectivity technologies and protocols for IoT systems.

CO3: Apply data analytics techniques to extract insights from IoT data.

CO4: Design and develop secure IoT applications and solutions.

CO5: Analyze and mitigate security vulnerabilities and threats in IoT environments.

CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	2	3	2	-	-	-	-	-	-		-
CO3	3	3	3	2	-	-	-	-	-	-	-
CO4	2	2	3	2	-	-	-	-	--	-	-
CO5	2	3	2	3	-	-	-	-	-	-	-

Course Content:

Module 1: 4L
Introduction to IoT and its Architecture,Overview of the Internet of Things (IoT), its enabling technologies, and real-world applications., IoT architecture and reference models (e.g., layered architecture, fog and edge computing)., IoT devices, sensors, and actuators., M2M communication and its role in IoT.

Module 2: 4L
IoT Connectivity and Protocols, IoT communication protocols (e.g., MQTT, CoAP, HTTP, DDS).
Network layer protocols (e.g., 6LoWPAN, RPL).,IoT access technologies (e.g., Wi-Fi, Bluetooth, Zigbee, LoRaWAN)., Network Security and challenges in IoT.

Module 3: 5L
IoT Data Acquisition, Storage, and Processing, Data generation, collection, and sensing in IoT.
Data preprocessing techniques for IoTdata.,IoT data storage models (e.g., cloud-based, edge-based).
Introduction to IoT data platforms (e.g., AWS IoT, Azure IoT, ThingWorx).

Module 4: 6L
Data Analytics for IoT, Introduction to data analytics for IoT, including descriptive, diagnostic,

predictive, and prescriptive analytics., Machine learning algorithms and their application in IoT analytics., Big data analytics tools and technologies (e.g., Hadoop, Spark)., Edge streaming analytics and its relevance in IoT., Data visualization techniques and tools for IoT data.
Case studies on IoT analytics applications (e.g., smart manufacturing, smart cities, healthcare).

Module 5: 6L
IoT Security Fundamentals and Risk Analysis, Overview of security and privacy in information systems and IoT., Principles of IoT security and privacy preservation.
IoT security threats, risks, and vulnerabilities (e.g., insecure hardware/interfaces, data privacy issues, denial-of-service)., Security architectures and models for IoT., Formal risk analysis structures (e.g., OCTAVE, FAIR) and their application in IoT.
IT and OT security practices and their variations in IoT environments.

Module 6: 5L
Secure IoT Development and Management, Security in frontend sensors and equipment.
Secure IoT lower and upper layers., Secure communication links in IoT., Backend security for IoT systems (e.g., secure databases)., Authentication, authorization, and access control in IoT.
Data integrity and confidentiality in IoT., IoT security protocols and key management., Vulnerability assessment, penetration testing, and security testing of IoT systems., Security management and considerations for IoT deployment.

Module 7: 4L
Industrial IoT (IIoT) and Security Considerations, IoT architecture, protocols, and applications.
Security challenges and best practices in industrial IoTenvironments., Case studies on secure IIoT implementations.

Text Book

1. *IoT Security* by MadhusankaLiyanage, AnBraeken, Pardeep Kumar & Mika Ylianttila — Wiley (February 2020)
2. Internet of Things and Big Data Analytics-Based Manufacturing by Rana et al. — CRC Press (Oct 2024)
3. *Internet of Things Security and Privacy* by Ali Ismail Awad, Atif Ahmad, Kim-Kwang Raymond Choo &SaqibHakak— CRC Press (Dec 2023)

Paper Name: Deep Learning
Paper Code: CS(EC)701B
Contact (Periods/Week): 3:0:0
Credit Point: 3
No. of Lectures: 35

Prerequisite:
1. A solid background in Statistics, Calculus, Linear Algebra and Probability.
2. Good Exposure of Python packages like, NumPy, Pandas, Matplotlib, Scikit-learn

Course Objective(s):
To introduce the fundamental techniques and principles of Neural Networks
To study the different models in ANN and their applications
To familiarize deep learning concepts with CNN and RNN

Course Outcome(s):
On completion of the course students will be able to
CO1: Understand the basic concepts in Neural Networks and Deep Learning and applications.
CO2: Understand the Shallow & Deep Neural Networks.
CO3: Understand the Convolution Neural Network models for Images.
CO4: Understand the Recurrent Neural Network models for Sequence data.

Module 1: Introduction to Neural Networks and Deep Learning [8L]
What is a Neural Network? Supervised Learning with Neural Networks, why is Deep Learning taking off? Binary Classification, Logistic Regression, Logistic Regression Cost Function, Gradient Descent, Derivatives, Computation Graph, Derivatives with a Computation Graph, Logistic Regression Gradient Descent, Vectorization, Vectorizing Logistic Regression, Vectorizing Logistic Regression's Gradient Output.
Module 2: Shallow Neural Network & Deep Neural Network [9L]
Neural Networks Overview, Neural Network Representation, computing a Neural Network's Output, VectorizingAcross Multiple Examples, Activation Functions, why do you need NonLinear Activation Functions? Derivatives of Activation Functions, Gradient Descent for Neural Networks, Back propagation Intuition, Random Initialization, Deep L-layer Neural Network, Forward Propagation in a Deep Network, getting your Matrix Dimensions Right, Building Blocks of Deep Neural Networks, Forward and Backward Propagation, Parameters vs Hyper parameters.
Module 3: Foundations of Convolutional Neural Networks [9L]
Computer Vision, Edge Detection Example, Padding, Strided Convolutions, Convolutions Over Volume, One Layer of a Convolutional Network, Simple Convolutional Network Example, Pooling Layers, Why Convolutions? Classic Networks, ResNets, Why ResNets Work? Networks in Networks and 1X1 Convolutions, Inception Network, MobileNet Architecture, EfficientNet, Using Open-Source Implementation, Transfer Learning, Data Augmentation; Object Localization, Landmark Detection, Object Detection, Convolutional Implementation of Sliding Windows, Bounding Box Predictions, Non-max Suppression, Anchor Boxes, YOLO Algorithm, Semantic Segmentation with U-Net, Transpose Convolutions, U-Net Architecture.
Module 4: Sequence Models [9L]
Why Sequence Models? Notation, Recurrent Neural Network Model, Backpropagation Through Time, Different Types of RNNs, Language Model and Sequence Generation, Sampling Novel Sequences, Vanishing Gradients with RNNs, Gated Recurrent Unit (GRU),Long Short Term Memory (LSTM),Bidirectional RNN, Deep RNNs, Word Representation, Using Word Embeddings, Properties of Word Embeddings, Embedding Matrix, Learning Word Embeddings,Word2Vec,GloVe Word Vectors, Sentiment Classification, Debiasing Word Embeddings, Basic Sequence Models, Picking the Most Likely

Sentence, Beam Search, Refinements to Beam Search, Error Analysis in Beam Search, Attention Model, Speech Recognition, Trigger Word Detection, Transformer Network Intuition, Self-Attention, Multi-Head Attention.

Text Books:

1. Charu C. Aggarwal,"Neural Networks and Deep Learning: A Textbook", Springer; 1st ed. 2018 edition
2. Ian Goodfellow, YoshuaBengio and Aaron Courville, " Deep Learning", published by MIT Press

Reference Books:

1. Francois Chollet, "Deep Learning with Python", Manning Publications; 1st edition
2. Simon Haykin, "Neural Networks and Learning Machines", Pearson Prentice Hall, 3rd Edition
3. Martin T. Hagan, Howard B. Demuth, Mark H. Beale, Orlando De Jess, "Neural Network Design (2nd Edition)".

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	2	3	3	3	-	-	-	-	-	2
CO2	-	2	2	2	1	-	-	-	-	-	2
CO3	-	2	3	3	3	3	-	-	-	-	3
CO4	3	2	2	2	1	3	2	-	-	-	2

Course Name: Cyber Security &Cryptography
Course Code: CS(EC)701C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites
1. Knowledge of Computer Networks and Operating Systems fundamentals
2. Understanding of Discreet Mathematics concepts

Course Outcome(s):
Graduates of the ECE program will be able to
CO1 Acquire fundamental knowledge and compare different cryptographic techniques.
CO2 Develop and design various block cipher and stream cipher models
CO3 Demonstrate the principles of public key cryptosystems, hash functions and digital Signature.
CO4 Analyse varied network security tools and authentication applications
CO5 Develop and apply email security, IP security, web security services and mechanisms

Course Contents

Module-1 [7L]
Introduction - Services, Mechanisms, and Attacks, OSI security architecture, Network security mode, Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography), Finite Fields and Number Theory: Groups, Rings, Fields,Modular arithmetic, Euclid's algorithm, Polynomial Arithmetic, Prime numbers, Fermat's and Euler's theorem, Testing for primality -The Chinese remainder theorem - Discrete logarithms.
Module-2 [9L]
Data Encryption Standard- Block cipher principles, block cipher modes of operation, Advanced Encryption Standard (AES), Triple DES, Blowfish, RC5 algorithm, Public key cryptography: Principles of public key cryptosystems, The RSA algorithm, Key management - Diffie Hellman Key exchange, Elliptic curve arithmetic, Elliptic curve cryptography.
Module-3 [6L]
Authentication requirement, Authentication function, MAC, Hash function, Security of hash function and MAC, MD5, SHA, HMAC, CMAC, Digital signature and authentication protocols, DSS, ElGamal, Schnorr.
Module-4 [7L]
Authentication applications, Kerberos, X.509, Internet Firewalls for Trusted System: Roles of Firewalls, Firewall related terminology- Types of Firewalls, Firewall designs principles, SET for E- Commerce Transactions, Intruder, Intrusion detection system, Virus and related threats, Countermeasures, Trusted systems, Practical implementation of cryptography and security.
Module-5 [7L]
E-mail Security: Security Services for E-mail-attacks possible through E-mail, Establishing keys privacy, authentication of the source, Message Integrity, Non-repudiation, Pretty Good Privacy, S/MIME, IP Security: Overview of IPSec, IPv4 and IPv6-Authentication Header, Encapsulation Security Payload (ESP), Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding), Web Security: SSL/TLS Basic Protocol, computing the keys, client authentication, PKI as deployed by SSL Attacks fixed in v3, Exportability, Encoding, Secure Electronic Transaction.

Textbooks
[1] Kahate, A. (2013). Cryptography and network security. Tata McGraw-Hill Education.

[2] Forouzan, B. A., &Mukhopadhyay, D. (2015). Cryptography and network security. New York, NY: Mc Graw Hill Education (India) Private Limited.

Reference Books

[1] Stallings, W. (2006). Cryptography and network security, 4/E. Pearson Education India.
[2] Daras,N.J., &Rassias, M. T.(Eds.).(2015).Computation, cryptography, and network security(pp.253-287). Springer.
[3] Kumar, A., & Bose, S. (2017). Cryptography and network security. Pearson Education India.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1
CO 1	2	2	3	1	3	1	1	1	2	1	1
CO 2	2	2	3	3	1	-	-	1	2	1	1
CO 3	2	3	3	2	2	2	2	1	2	2	1
CO 4	3	2	3	2	1	-	-	1	2	1	1
CO 5	1	3	3	2	1	1	-	1	2	1	2

Subject: Blockchain Technology
Code: CS(EC)701D
Credit: 3
Contact: 36
Prerequisite: The students must have concept of Distributed Systems, Computer Networks, Cryptography, Python Programming Language. Course Objective: The objective of the course is to learn and understand Blockchain technology in detail and identifies the application potentials of this technology.
Course Outcome:
After completion of this course students will be able to
CO-1: Understand the basic concepts of blockchain and it's architectures.
CO-2: Analyse different issues in the domain of blockchain and understand the practical applications of blockchain.
CO-3: Evaluate and analyse different solutions for the real life problems related to the blockchain. **CO-4**: Design different solution applying and analysing concept of Block chain.
CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	--	--	--	--	--	--	--
CO2	2	--	3	2	--	--	--	--	--	--	--
CO3	3	3	2	3	--	--	--	--	--	--	--
CO4	3	--	3	--	--	--	--	--	--	--	3

Course Contents:
MODULE I: Centralized - Distributed Systems: [6L]
Client-Server Model, Distributed System, P2P Network Model, Distributed Database, Two General Problem in distributed database, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete.
MODULE II: Security, Trust and Privacy: [6L]
Confidentiality; Integrity; Availability; Authentication; Authorization; Access Control; Accounting;NonRepudiation, Symmetric Key and Asymmetric Key Cryptography, Hash function, Merkletreehash, Digital Signatures – RSA, Schnorr, and ECDSA, Memory Hard Algorithm, Zero Knowledge Proof, User privacy.
MODULE III: Fundamentals of Blockchain: [6L]
Introduction, Benefits over traditional distributed database, Blockchain Network, Data structure ofblock, Block construction and addition, Block mining mechanisms, Merkle Pa-tricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain policy, Real-time application of Blockchain, Soft & Hard Fork, Private, Public, and Consortium blockchain.
MODULE IV: Consensus algorithms in Blockchain:[9L]
Distributed Consensus, Nakamoto consensus, Proof of Work (PoW), Proof of Stake (PoS), Proof of Burn (PoB), Delegated Proof of Stake (DPoS), Byzantine Fault Tolerance (BFT), Practical Byzantine Fault Tolerance (PBFT), Ripple Protocol Consensus Algorithm (RPCA), Difficulty Level, Sybil Attack, Energy utilization and alternate.
MODULE V: Cryptocurrency and Blockchain Applications: [9L]
History, Distributed Ledger Technology (DLT),Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contracts and Distributed Applications (Apps), GHOST, Vulnerability, Attacks, Sidechain, Namecoin, Stakeholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy, Application of Blockchain in Finance and Banking, Energy trading, Internet of Things (IoV, IoD, IIoT, Smart city, Smart Home, and so on), Medical Record Management System, Real estate business, Entertainment, Future scope of Blockchain.

Textbooks:

1. Roger Wattenhofer, Distributed Ledger Technology: The Science of the Blockchain, SecondEdition, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Gold feder, Bitcoin and Cryp-tocurrencyTechnologies: A Comprehensive Introduction, Princeton University Press, 2016.
3. Andreas M. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, O'Reilly Publication House, 2014.

Reference books:

1. Melanie Swan Blockchain: Blueprint for a new Economy, O'Reilly Publication House, 2015.
2. Andreas M. Antonopoulos and Dr. Gavin Wood, Mastering Ethereum Building Smart Contracts and DApps, O'Reilly Publication House, First Edition, 2018.

Paper name: Project Management and Finance
Code: HU(EC)701
Contact Hour-02 (L=02; T:0P :0)
Number of Lectures:28

Course Objectives

1. To introduce students to the fundamental concepts and components of Project Management.
2. To develop the ability to perform preliminary project screening and appraisal, enabling students to identify viable project opportunities and assess their potential.
3. To provide knowledge and analytical skills for conducting comprehensive feasibility studies.
4. To impart foundational knowledge of Financial Management principles.
5. To enhance decision-making abilities related to financial management, particularly in areas such as investment analysis, cost control, and project financing.

Course Outcomes:

CO1: Understand and explain the fundamental principles, tools, and techniques of project management including planning, scheduling, monitoring, and control in engineering projects.
CO2: Apply project screening and feasibility analysis methods to assess the technical, market, and operational viability of engineering projects.
CO3: Analyze financial data to evaluate project investments, including concepts such as time value of money, break-even analysis, and risk-return trade-off.
CO4: Demonstrate decision-making capabilities in project financing and resource allocation, using basic financial management principles and tools.

Course Content:

UNIT I: BASICS OF PROJECT MANAGEMENT: Meaning, Definition and scope and Need for Project Management - The Project Life Cycle - Phases of Project Management Life Cycle - Project Management Processes. **(2L)**
UNIT II: PROJECT IDENTIFICATION AND SELECTION: Preliminary Screening of Projects. Project Identification Process- Sources of Financial resources - Pre-Feasibility Study - Feasibility Studies: Market Feasibility, Financial Feasibility and Technical Feasibility (**3L)**
UNIT III: PROJECT ORGANIZATION AND PLANNING: Project manager, Cross-functional team, Dedicated project organization, Influence project organization, Matrix organization, Advantages and disadvantages of project organizations, Selection of project organization, Work Breakdown Structure (WBS), Integration of project organization and WBS, WBS and responsibility matrix. **(3L)**
UNIT IV: PROJECT SCHEDULING AND RESOURCE MANAGEMENT: Gant chart, Milestone chart, Network techniques: PERT and CPM, AON and AOA representation. **(4L)**
UNIT-V: NATURE AND SCOPE OF FINANCIAL MANAGEMENT
Role of financial management in business decision, the Firm and its Environment: Forms of business ownership. **(2L)**
UNIT-VI: BALANCE SHEET AND PROFIT AND LOSS STATEMENTS
Tools of Financial Analysis: Funds flow analysis - sources and uses of funds, measurements of cash flow, Revenue costs. **(3L)**
Investment Management: Capital Budgeting Techniques. PBP, ARR, Time Value of Money, NPV v/s IRR. Risk Analysis. **(3L)**
UNIT-VII: PROFIT RELATIONSHIPS
Break even analysis, ratio analysis, of operating and financial leverages, Working Capital Management, Credit Policy. **(3L)**
Financial Decision Making: Sources of raising capital, Internal financing, Cost of capital, Balanced Capital Structure. Capital Structure Theories, Dividend Policy & its Theories. (**5L**)

Textbooks:

1. R. Paneerselvam, P. Senthil Kumar, Project Management, PHI.

2. S. N. Maheshwari, Financial Management: Principles andApplications ,Sultan Chand & Sons

Reference Books:

1. Prasanna Chandra, Projects, Planning, Analysis, Selection, Financing, Implementation and Review, Tata McGraw Hill Pvt. Ltd., New Delhi.
2. K. Nagrajan, Project Management, New Age International Publishers,
3. Vasanth Desai, Project Management, Himalaya Publications.
4. Clifford F. Gray, Erik W. Larson, Project Management, the Managerial Emphasis, Tata McGraw Hill.
6. 7. M.Y. Khan and P. K. Jain, Financial Management: Text, Problems and Cases, Tata McGraw Hill Pvt. Ltd., New Delhi.

Subject Name: Embedded System Lab
Subject Code: EC 791
Credit: 1.5

Course Prerequisites:

Students should have a fundamental understanding of:

- **Digital Electronics:** Logic gates, basic digital circuits, number systems.
- **Microcontrollers/Microprocessors (Basic):** Architecture, instruction sets, memory organization.
- **Programming Concepts:** C/C++ programming language, basic data structures, control flow.
- **Basic Electronic Components:** Resistors, capacitors, diodes, transistors, sensors.
- **Operating Systems (Basic):** Familiarity with Linux commands for Raspberry Pi section.

Course Objectives:

1. **Understand and apply fundamental concepts of embedded systems** using popular development boards like Arduino, Raspberry Pi, PIC, and ARM.
2. **Gain practical experience in interfacing various sensors and actuators** with microcontrollers and microprocessors.
3. **Develop embedded C/C++ programs** for different embedded platforms to control hardware and acquire data.
4. **Implement data logging and communication protocols** for embedded applications.
5. **Troubleshoot and debug embedded hardware and software systems.**
6. **Apply embedded systems knowledge to real-world problems** such as environmental monitoring, home automation, and data acquisition.

Course Outcomes (COs):

Upon successful completion of these modules, students will be able to:

- **CO1: Arduino Interfacing:** Design and implement embedded systems using Arduino for real-time sensor data acquisition and display (temperature, humidity, current, LPG, air quality, barometric pressure).
- **CO2: Raspberry Pi System Development:** Interface current and voltage sensors with Raspberry Pi, implement data logging systems, and store energy consumption data in a database.
- **CO3: PIC Microcontroller Programming:** Write and debug programs to interface PIC microcontrollers with various peripherals including LEDs, 7-segment displays, switches, LCDs (4-bit and 8-bit mode), relays, fingerprint sensors, GSM modems, and

Zigbee modules.

- **CO4: ARM System Exploration:** Familiarize themselves with ARM evaluation systems, interface and control LEDs, integrate real-time clocks, interface keyboards, and perform basic image processing tasks on ARM Cortex-M microcontrollers.

- **CO5: Sensor Data Acquisition on ARM:** Interface various sensors (temperature, humidity, gas, air quality) with ARM microcontrollers for data acquisition and demonstrate proficiency in real-time image processing algorithm design and optimization.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	2	3	1	-	2	2	1	2
CO2	3	3	3	3	3	2	-	2	2	2	3
CO3	3	2	3	2	3	1	-	2	2	1	2
CO4	3	2	3	2	3	1	-	2	2	1	2
CO5	3	3	3	3	3	2	-	2	2	2	3

It is suggested to perform at least one from Module-1, one from Module-2, 4 from Module-3 and 4 from Module-4

Module-1: Arduino-based experiments

1. Connect an LCD to the Arduino to show real-time Sensors (temperature, humidity, current, LPG leakage, air quality) data locally.

2. Integrate a barometric pressure sensor (like BMP180 or BMP280) to measure atmospheric pressure.

Module-2: Raspberry Pi-based experiments

1. Interface current and voltage sensors to the Raspberry Pi to measure power consumption from different appliances or circuits within the home.

2. Implement a data logging system on the Raspberry Pi to continuously record energy consumption data. Store the data in a database for further analysis.

Module-3: ARM based experiments

1. Familiarization with ARM development board.
2. Interface and control a LED.

3. Interfacing with a real time clock using a serial port to display time.
4. Interface a Keyboard and display the keystrokes on a LCD.
5. Interfacing Sensors (temperature and Humidity, gas sensor, air quality sensor etc) with ARM Microcontrollers for Data Acquisition
6. "Design and Optimization of Real-Time Image Processing Algorithms on ARM Cortex Series Microcontrollers"

Module-4: PIC-based experiments

1. write a program to interface PIC microcontroller with LED and glow LEDs on and off.
2. Write a program to Interface PIC microcontroller with Seven Segment display.
3. Write a program to Interface PIC microcontroller with Switch.
4. Write a program to Interface PIC microcontroller with LCD using 4 bit and 8-bit mode.
5. Write a program to Interface PIC microcontroller with Relay.
6. Write a program to Interface PIC microcontroller with Fingerprint Sensor
7. Write a program to Interface PIC microcontroller with GSM Modem
8. Write a program to Interface PIC microcontroller with Zigbee.

Projects:

- Arduino Weather Station with Wireless Data Logging
- Create a web-based or mobile interface that displays real-time energy usage for different appliances or areas of the home. Users should be able to access this interface remotely.
- "ARM-Based Digital Signal Processing for Audio Applications"
- ARM Cortex-M-based Smart Home Automation System"
- Face id-based attendance system using ARM Cortex

Subject: Rapid Prototyping Lab
Course Code: PR(EC)792
Course Type: Laboratory
Credits: 1.5 (L: 0, T: 0, P: 3)

Prerequisites: Basic Electronics, Microcontrollers, Embedded Systems

Course Objectives

- To introduce students to rapid prototyping tools and techniques used in electronics and product design.
- To develop skills in hardware prototyping using microcontrollers, sensors, and actuators.
- To familiarize students with PCB design, 3D modeling, and fabrication processes.
- To enable students to integrate software and hardware for functional prototypes.
- To prepare students for innovative product development and real-time applications.

Course Outcomes (COs) (After the completion of the course, students will be able to……)

- CO1: Demonstrate the use of rapid prototyping tools and basic fabrication techniques.
- CO2: Design and assemble simple electronic circuits using breadboards and PCBs.
- CO3: Interface microcontrollers with sensors and actuators for functional prototypes.
- CO4: Develop 3D models and fabricate electronic enclosures using 3D printing.
- CO5: Integrate hardware and software components to create working prototypes for real-world applications.

Suggested Prototyping Attempts

1. Introduction to rapid prototyping tools (Arduino, Raspberry Pi, 3D printers, CNC machines).
2. Circuit prototyping using breadboards and soldering techniques.
3. PCB design and fabrication using EDA tools (e.g., KiCAD/Eagle).
4. Microcontroller programming for basic input/output operations.
5. Interfacing sensors (temperature, ultrasonic, IR) and data acquisition.
6. Actuator control (DC motors, servo motors, stepper motors).
7. Wireless communication module integration (Bluetooth/Wi-Fi).
8. Introduction to 3D modeling and printing of electronic enclosures.
9. Mini project: Design and prototype a functional embedded system/product.
10. Testing and debugging techniques for rapid prototypes.
11. Design a digital system using Verilog and implement it using FPGA.
12. Design and layout of an A/D and D/A convertor (more than 4 bit) using T-SPICE.

Hardware/Software Tools

- Microcontroller boards: Arduino, Raspberry Pi, ESP32
- Sensors and actuators kit
- PCB Design Software: KiCAD, Eagle
- 3D CAD software: Fusion 360 / SolidWorks
- Fabrication tools: 3D printer, soldering station, CNC router

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	3	1	1	-	1	1	2
CO2	3	3	3	2	3	-	-	-	1	1	2
CO3	3	3	3	3	3	-	-	-	2	2	3
CO4	3	2	3	2	3	1	1	1	2	2	3
CO5	3	3	3	3	3	2	2	1	3	3	3

Course Name: Project-II
Course Code: EC782
Credit: 4

The object of Project Work II is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work.

The assignment to normally include:

1. Survey and study of published literature on the assigned topic
2. Working out a preliminary Approach to the Problem relating to the assigned topic
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility
4. Preparing a Written Report on the Study conducted for presentation to the Department
5. Final Seminar, as oral Presentation before a departmental committee.

4th Year 8th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
B. PRACTICAL									
1	PRJ	Project	EC881	Grand Viva	0	0	0	8	4
2	PRJ	Project	EC882	Internship /Entrepreneurship	0	0	0	8	4
Total of Theory, Practical								20	8