ELECTRONICS AND COMMUNICATION ENGINEERING

(For the batches admitted from the academic year 2021-22)

Vision

- To produce technically competent and research-oriented Electronics and Communication Engineers to meet the Industrial and Social requirements.

Mission

- To impart quality technical education in the field of Electronics and Communication Engineering through state-of-the art facilities and effective teaching learning process.
- To enrich the faculty and students with research and consultancy skills through Industry-Interaction and Training in Emerging areas of Electronics and Communication Engineering.
- To develop lifelong learning, leadership qualities and ethical values in learners to meet the societal and industrial needs.

Institutional Objectives

- To create a conducive and competitive environment for students through curricular and extra-curricular activities.
- Promote the culture of research among the faculty.
- To promote synergetic alliances with premier Institutions, Industry, CSIR laboratories and various Government organizations for Collaborative Research Projects.
- To promote economic and social enrichment of the society through Skill Development programmes, Entrepreneurship, and extension activities.
- To introduce demand-driven new UG&PG academic programmes.
- To ensure a high degree of quality in terms of providing infrastructure, research ambience, faculty and staff development.

Core Values

- *Thirst for Quality Education:* The stake holders of the institute particularly management, employees and students of the institution have a consistent thirst for quality improvement of the processes and services in the institution.
- *Lifelong Learning:* In the fast-changing technological world, acquiring a special skill at one point of time will not be enough for ever long survival. Hence to flourish in the workplace and to bring in innovations in the ways of doing, employee, student as well as alumni must be continuous learners and tech savvy.

- *Diversity and Participation:* PBRVITS promotes the involvement of faculty, staff, and students from all social, economic, ethnics, cultural and religious backgrounds to get the synergy of combining the diversified agents. The focus is on involving students to exhibit their talent in various curricular and co-curricular activities and strengthening alumni link to share their experiences to the students.
- *Academic Integrity and Accountability:* Management induces accountability in the employees for the career of the students and the academic leadership establishes a mentoring mechanism for realization of responsibilities of students towards their parents and in turn to the society.

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(For the batches admitted from the academic year 2021-22)

INDUCTION PROGRAM (3 weeks duration)
❖ Physical activity ❖ Creative Arts ❖ Universal Human Values ❖ Literary ❖ Proficiency Modules ❖ Lectures by Eminent People ❖ Visits to local Areas ❖ Familiarization to Dept./Branch & Innovations

Semester I (First Year)

S. No	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	BS	21A110101	Calculus and Special Functions	3	0	0	3	30	70	100
2	BS	21A110102	Mathematical Methods	3	0	0	3	30	70	100
3	ES	21A020301	Fundamentals of Electrical Circuits	3	0	0	3	30	70	100
4	ES	21A050302	C Programming & Data Structures	3	0	0	3	30	70	100
5	ES	21A030301	Engineering Drawing	1	0	4	3	30	70	100
6	ES	21A020302	Fundamentals of Electrical Circuits Lab	0	0	3	1.5	30	70	100
7	ES	21A050303	C Programming & Data Structures Lab	0	0	3	1.5	30	70	100
8	HSMC	21A110201	Communicative English Lab	0	0	2	1	30	70	100
Total							**19**			**800**

Semester II (First Year)

S. No	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	BS	21A110103	Differential Equations & Vector Calculus	3	0	0	3	30	70	100
2	BS	21A110104	Applied Physics	3	0	0	3	30	70	100
3	BS	21A110105	Applied Chemistry	3	0	0	3	30	70	100
4	HSMC	21A110202	English for Professionals	2	0	0	2	30	70	100
5	ES	21A040301	Electronic Devices & Circuits	3	0	0	3	30	70	100
6	BS	21A110108A	Applied Physics Lab	0	0	3	1.5	30	70	100
7	BS	21A110108B	Applied Chemistry Lab	0	0	3	1.5	30	70	100
8	ES	21A050301	Engineering & IT Workshop Lab	0	0	3	1.5	30	70	100
9	ES	21A040302	Electronic Devices & Circuits Lab	0	0	3	1.5	30	70	100
10	MC	21A000001	Environmental Science	2	0	0	0	30	---	---
Total							**20**			**900**

Semester III (Second Year)

S. No	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	BS	21A110112	Complex Variables and Transforms	3	0	0	3	30	70	100
2	PC	21A040401	Signals & Systems	3	0	0	3	30	70	100
3	PC	21A040402	Pulse and Digital Circuits	3	0	0	3	30	70	100
4	PC	21A040403	Probability Theory and Stochastic Process	3	0	0	3	30	70	100
5	ES	21A020305	Electrical Technology	3	0	0	3	30	70	100
6	PC	21A040404	Pulse and Digital Circuits Lab	0	0	3	1.5	30	70	100
7	PC	21A040405	Basic Simulation Lab	0	0	3	1.5	30	70	100
8	ES	21A020306	Electrical Technology Lab	0	0	3	1.5	30	70	100
9	SC	21A050701	Python Programming	1	0	2	2	30	70	100
10	MC	21A000002	Constitution of India	2	0	0	0	30	-	-
Total							**21.5**			**900**

Semester IV (Second Year)

S. No	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	ES	21A040303	Control Systems	3	0	0	3	30	70	100
2	HSMC	21A110203	Managerial Economics & Financial Analysis	3	0	0	3	30	70	100
3	PC	21A040406	Digital System Design	3	0	0	3	30	70	100
4	PC	21A040407	Electronic Circuit Analysis & Design	3	0	0	3	30	70	100
5	PC	21A040408	Analog Communications	3	0	0	3	30	70	100
6	PC	21A040409	Digital System Design Lab	0	0	3	1.5	30	70	100
7	PC	21A040410	Electronic Circuit Analysis & Design Lab	0	0	3	1.5	30	70	100
8	PC	21A040411	Analog Communications Lab	0	0	3	1.5	30	70	100
9	SC	21A040701	PCB Design	1	0	2	2	30	70	100
Total							**21.5**			**900**
Internship-I (Community Service Project) during semester break										

Semester V (Third Year)

S. No	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	PC	21A040412	Electromagnetic Waves and Transmission Lines	3	0	0	3	30	70	100
2	PC	21A040413	Integrated Circuits and Applications	3	0	0	3	30	70	100
3	PC	21A040414	Digital Communications	3	0	0	3	30	70	100
4	OE-I		**Open Elective - I**	3	0	0	3	30	70	100
5	PE-1	21A040415 21A040416 21A040417	**Professional Elective - I** a) Data Communication and Networking b) Electronic Measurement and Instrumentation c) Concepts of Machine Learning	3	0	0	3	30	70	100
6	PC	21A040418	Integrated Circuits and Applications Lab	0	0	3	1.5	30	70	100
7	PC	21A040419	Digital Communications Lab	0	0	3	1.5	30	70	100
8	SC	21A040702	Programming Arduino	1	0	2	2	30	70	100
9	MC	21A000003	Universal Human Values	3	0	0	3	30	70	100
10	PROJ	21A040601	Internship - I Evaluation	-	-	-	1.5	--	--	100
Total							**24.5**			**1000**

Semester VI (Third Year)

S. No	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	PC	21A040420	Antennas & Microwave Engineering	3	0	0	3	30	70	100
2	PC	21A040421	Microprocessors and Microcontrollers	3	0	0	3	30	70	100
3	PC	21A040422	Digital Signal Processing	3	0	0	3	30	70	100
4	PE - II	21A040423 21A040424 21A040425	**Professional Elective -II** a) Optical Communications b) Smart Sensors c) VLSI Design	3	0	0	3	30	70	100
5	OE - II		**Open Elective -II**	3	0	0	3	30	70	100
6	PC	21A040426	Antennas & Microwave Engineering Lab	0	0	3	1.5	30	70	100
7	PC	21A040427	Microprocessors and Microcontrollers Lab	0	0	3	1.5	30	70	100
8	PC	21A040428	Digital Signal Processing Lab	0	0	3	1.5	30	70	100
9	SC	21A040703	RF System Design	1	0	2	2	30	70	100
10	MC	21A000004	Research Methodology	2	0	0	0	30	---	---
Total							**21.5**			**900**
Internship –II (Industry) during semester break										

Semester VII (Fourth Year)

S. No	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	PE - III	21A040429 21A040430 21A040431	**Professional Elective -III** a) Embedded System Design b) DSP Processors and Architecture c) Satellite Communications	3	0	0	3	30	70	100
2	PE - IV	21A040432 21A040433 21A040434	**Professional Elective-IV** a) Cellular & Mobile Communication b) Biomedical Signal Processing c) Radar Engineering	3	0	0	3	30	70	100
3	PE - V	21A040435 21A040436 21A040437	**Professional Elective -V** a) Digital Image Processing b) Advanced Microprocessors c) Nano Electronics	3	0	0	3	30	70	100
4	OE - III		**Open Elective – III**	3	0	0	3	30	70	100
5	OE - IV		**Open Elective – IV**	3	0	0	3	30	70	100
6	HSMC	21A110204	Management Science	3	0	0	3	30	70	100
7	SC	21A050707	Software Testing Tools	1	0	2	2	30	70	100
8	PROJ	21A040602	Internship-II Evaluation	-	-	-	3	--	--	100
Total							**23**			**800**

Semester VIII (Fourth Year)

S. No	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	PROJ	21A040603	Full Internship & Major Project	-	-	12	10	110	140	250
2	PROJ	21A040604	Technical Seminar	-	-	4	2	50	-	50
Total							**12**			**300**

Open Elective – I

S. No	Course Code	Course Title
1	21A010501	Air Pollution and Control
2	21A020501	Electric Vehicles
3	21A020502	Electrical Distribution Systems
4	21A030501	Robotics
5	21A030502	Basics of Mechanical Engineering
6	21A050501	Operating Systems Concepts
7	21A050502	Computer Architecture & Organization

Open Elective – II

S. No	Course Code	Course Title
1	21A010502	Environmental Pollution and Control
2	21A020503	Smart Grid
3	21A020504	Energy Storage Systems
4	21A030503	Automation in Industries
5	21A030504	Rapid Prototyping
6	21A050503	Java Programming
7	21A050504	Basics of Database Management Systems

Open Elective – III

S. No	Course Code	Course Title
1	21A010503	Disaster Management and Mitigation
2	21A020505	Renewable Energy Systems
3	21A020506	Concepts of Electrical Drives and Applications
4	21A030505	Optimization Techniques
5	21A030506	Global Warming and Climate Changes
6	21A050505	Introduction to Internet of Things
7	21A050506	Web Technologies for Beginners

Open Elective – IV

S. No	Course Code	Course Title
1	21A010504	Cost Effective Housing Techniques
2	21A020507	Energy Conservation and Management
3	21A020508	Basics of Power Electronics
4	21A030507	Basics of Automotive Engineering
5	21A030508	Basics of Total Quality Management
6	21A050507	Cloud Computing - AWS
7	21A050508	Basics of Cryptography & Network Security

COURSES OFFERED FOR HONOURS DEGREE IN ECE

S. No	Course Code	Course Title	Hours per week		Credits	CIE	SEE	Total
			L	T	C			
1	21A04HN01	Advanced MOSFET Modeling	3	1	4	30	70	100
2	21A04HN02	VLSI Signal Processing	3	1	4	30	70	100
3	21A04HN03	CAD for VLSI	3	1	4	30	70	100
4	21A04HN04	Test and Testability	3	1	4	30	70	100
5	21A04HN05	MOOC – 1	-	-	2	-	-	-
6	21A04HN06	MOOC – 2	-	-	2	-	-	-

LIST OF MINORS OFFERED TO ECE

S. No	Course Code	Course Title	Department offering the course
1	21A050415	Design and Analysis of Algorithms	CSE & ALLIED
2	21A050418	Mobile Computing	CSE & ALLIED
3	21A310402	Artificial Intelligence and Neural Networks	CSE & ALLIED
4	21A350401	Sensors and Internet of Things	CSE & ALLIED

Course Code	CALCULUS AND SPECIAL FUNCTIONS (Common to all branches)		L	T	P	C
21A110101			3	0	0	3
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- This course will illuminate the students in the concepts of calculus and Mean value theorems.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Utilize mean value theorems to real life problems.

CO2: Familiarize with functions of several variables which is useful in optimization.

CO3: Students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional coordinate systems.

CO4: Students will also learn important tools of calculus in higher dimensions. Students will become familiar with 3- dimensional coordinate systems.

CO5: Utilize special functions in evaluating definite integrals.

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof) related problems.

Learning Outcomes: At the end of this unit, students should be able to

- Translate the given function as series of Taylor's and Maclaurin's with remainders (L3)
- Analyze the behaviour of functions by using mean value theorems (L3)

UNIT – II (12 Hrs)

Multi variable calculus: Partial derivatives, total derivatives, chain rule, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

Learning Outcomes: At the end of this unit, students should be able to

- Find partial derivatives numerically and symbolically and use them to analyze and interpret the way a function varies. (L3)
- Acquire the Knowledge maxima and minima of functions of several variable (L1)
- Utilize Jacobian of a coordinate transformation to deal with the problems in change of variables (L3)

UNIT – III (10 Hrs)

Double Integrals: Evaluation of Double integrals, change of order of integration, change of variables. Areas using Double Integrals.

Learning Outcomes: At the end of this unit, students should be able to

- Evaluate double integrals of functions of several variables in two dimensions using Cartesian and polar coordinates (L5)
- Apply double integration techniques in evaluating areas bounded by region (L4)

UNIT – IV (10 Hrs)

Triple Integrals: Evaluation of triple integrals, change of variables between Cartesian, cylindrical and spherical polar co-ordinates, volumes using triple integrals.

Learning Outcomes: At the end of this unit, students should be able to

- Evaluate triple integrals in Cartesian, cylindrical and spherical polar coordinates. (L5)
- Apply triple integration techniques in evaluating volumes. (L4)

UNIT – V (12 Hrs)

Beta and Gamma functions: Beta and Gamma functions and their properties, relation between beta and gamma functions, evaluation of definite integrals using beta and gamma functions.

Learning Outcomes: At the end of this unit, students should be able to

- Understand beta and gamma functions and its relations (L2)
- Conclude the use of special function in evaluating definite integrals (L4)

TEXTBOOKS:

1. "Higher Engineering Mathematics", S. Grewal, Khanna Publishers, 44/e, 2017.
2. "Advanced Engineering Mathematics", Erwin Kreyszig, John Wiley & Sons,10/e, 2011.

REFERENCE BOOKS:

1. "Advanced Engineering Mathematics", R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 3/e, 2002.

2. "Calculus", George B. Thomas, Maurice D. Weir and Joel Hass, Thomas, Pearson Publishers, 13/e, 2013.
3. "Advanced Modern Engineering Mathematics", Glyn James, Pearson publishers, 4/e, 2011.
4. "Advanced Engineering Mathematics", Michael Greenberg, Pearson Education, 9th Edition.
5. "Advanced Engineering Mathematics with MATLAB", Dean G. Duffy, CRC Press
6. "Advanced Engineering Mathematics", Peter O'Neil, Cengage Learning.
7. "Engineering Mathematics Volumes-I &II", R.L. Garg Nishu Gupta, Pearson Education
8. "Higher Engineering Mathematics", B. V. Ramana, McGraw Hill Education
9. "Higher Engineering Mathematics", H. K. Das, Er. Rajnish Verma, S. Chand & Co. Ltd.
10. "Advanced Engineering Mathematics", N. Bali, M. Goyal, C. Watkins, Infinity Science Press.
11. "Engineering Mathematics", T.K.V Iyengar, B. Krishna Gandhi, S. Ranganatham, M.V.S.S.N Prasad, S. Chand Publications.

Course Code	MATHEMATICAL METHODS (Common to all branches)		L	T	P	C
21A110102			3	0	0	3
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- This course aims at providing use of matrix algebra techniques for practical applications.
- This course aims at providing the student with the knowledge on Various numerical Methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Develop the use of matrix algebra techniques that is needed by engineers for practical applications.

CO2: Understand and solve the roots of equation using Bisection method, Iterative method, Regula-Falsi method, Newton Raphson method and solve the system of algebraic equations.

CO3: Apply concept of interpolation and derive interpolating polynomial using Newton's forward and backward formulae, Lagrange's formulae, Gauss forward and backward formulae.

CO4: Solving initial value problems to ordinary differential equations.

CO5: Determine the process of finding integral equations using Simson's 1/3, Simson's 3/8 Rule and Trapezoidal rule and fitting a best curve using least squares method.

CO-PO MAPPING:

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

UNIT - I (10 Hrs)

Matrices: Rank of a matrix by echelon form, normal form. Solving system of homogeneous and non-homogeneous equations linear equations. Eigen values and Eigenvectors and their Properties, Cayley- Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, Diagonalization of a matrix.

Learning Outcomes: At the end of this unit, students should be able to

- Solving systems of linear equations, using technology to facilitate row reduction determine the rank, eigen values and eigenvectors (L3).
- Identify special properties of a matrix, such as positive definite, etc., and use this information to facilitate the calculation of matrix characteristics (L3)

UNIT - II (10 Hrs)

Solution of Algebraic & Transcendental Equations: Introduction-Bisection method-Iterative method-Regula-Falsi method-Newton Raphson method. System of Algebraic equations: Gauss Jordan Method-Gauss Seidal method.

Learning outcomes: At the end of this unit, students should be able to

- Calculate the roots of equation using Bisection method and Iterative method. (L3)
- Calculate the roots of equation using Regula-Falsi method and Newton Raphson method. (L3)
- Solve the system of algebraic equations using Gauss Jordan method and Gauss Seidal method. (L3)

UNIT - III (10 Hrs)

Interpolation: Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae. Gauss forward and backward formula, Stirling's formula, Bessel's formula.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of interpolation. (L2)
- Derive interpolating polynomial using Newton's forward and backward formulae. (L3)
- Derive interpolating polynomial using Lagrange's formulae. (L3)
- Derive interpolating polynomial using Gauss forward and backward formulae. (L3)

UNIT - IV (12 Hrs)

Numerical Solutions of Ordinary Differential Equations: Solution by Taylor's series-Picard's Method of successive Approximations- Euler's Method - Modified Euler's Method-Runge-Kutta Methods.

Learning Outcomes: At the end of this unit, students should be able to

- Solve initial value problems to ordinary differential equations using Taylor's method. (L3)
- Solve initial value problems to ordinary differential equations using Euler's method and Runge Kutta methods. (L3)

UNIT - V (12 Hrs)

Numerical Integration & Curve Fitting:

Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule

Fitting of straight line – second degree curve –Exponential curve –Power curve by the method of least squares.

Learning Outcomes: At the end of this unit, students should be able to

- Fit a best curve using method of least squares. (L3)
- Solve integral equations using Simson's 1/3 and Simson's 3/8 rule. (L3)
- Solve integral equations using Trapezoidal rule. (L3)

TEXTBOOKS:

1. “Higher Engineering Mathematics”, B. S. Grewal, Khanna publishers.
2. “Advanced Engineering Mathematics”, Erwin Kreyszig, Wiley India
3. “Introductory Methods of Numerical Analysis”, S. S. Sastry, PHI publishers.

REFERENCE BOOKS:

1. “Higher Engineering Mathematics”, B. V. Ramana, Mc Graw Hill publishers.
2. “Advanced Engineering Mathematics”, Alan Jeffrey, Elsevier Publishers
3. “A Text Book of Engineering Mathematics Vol – I”, T.K.V. Iyengar, B. Krishna Gandhi, S. Chand & Company.

Course Code	FUNDAMENTALS OF ELECTRICAL CIRCUITS (Common to EEE & ECE)		L	T	P	C
21A020301			3	0	0	3
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Basic characteristics of R, L, C parameters, their Voltage and Current Relations and Various combinations of these parameters
- The Single-Phase AC circuits and concepts of real power, reactive phasor, complex power, phase angle and phase difference
- Series and parallel resonances, bandwidth, current locus diagrams
- Network theorems and their applications
- Network Topology and concepts like Tree, Cut-set, Tie-set, Loop, Co-Tree

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Determine the equivalent impedance by using network reduction techniques and determine the current through, voltage across and power through any element

CO2: Determine the Dual of the network; develop the Cut Set and Tie-set Matrices for a given Circuit. Also understand various basic definitions and concepts

CO3: Determine the real power, reactive power, power factor of a given excitation.

CO4: Apply the network theorems suitably

CO5: Analyze the three-phase circuits with star-delta transformation

CO-PO MAPPING:

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

UNIT-I (12 Hours)

Introduction to Electrical & Magnetic Circuits: Electrical Circuits: Circuit Concept – Types of elements - Source Transformation-Voltage – Current Relationship for Passive Elements. Kirchhoff's Laws – Network Reduction Techniques- Series, Parallel, Series Parallel, Star-to-Delta or Delta-to-Star Transformation and Examples

Magnetic Circuits: Faraday's Laws of Electromagnetic Induction-Concept of Self and Mutual Inductance-Dot Convention-Coefficient of Coupling-Composite Magnetic Circuit-Analysis of Series and Parallel Magnetic Circuits, MMF Calculations.

Learning Outcomes: At the end of this unit, students should be able to

- Know about Kirchhoff's Laws in solving series, parallel, non-series-parallel configurations

in DC networks (L2)
- Know about voltage source to current source and vice-versa transformation in their representation (L2)
- Understand Faraday's laws (L2)
- Distinguish analogy between electric and magnetic circuits (L2)
- Understand analysis of series and parallel magnetic circuits (L2)

UNIT- II (12 Hours)
Network Topology: Definitions – Graph – Tree, Basic Cutset and Basic Tieset Matrices for Planar Networks – Loop and Nodal Methods of Analysis of Networks & Independent Voltage and Current Sources – Duality & Dual Networks. Nodal Analysis, Mesh Analysis.
Learning Outcomes: At the end of this unit, students should be able to
- Understand basic graph theory definitions which are required for solving electrical circuits (L2)
- Understand about loop current method (L2)
- Understand about nodal analysis methods (L2)
- Understand about principle of duality and dual networks (L2)
- Identify the solution methodology in solving electrical circuits based on the topology (L2)

UNIT- III (12 Hours)
Single Phase A.C Circuits: R.M.S, Average Values and Form Factor for Different Periodic Wave Forms – Sinusoidal Alternating Quantities – Phase and Phase Difference – Complex and Polar Forms of Representations, j-Notation, Steady State Analysis of R, L and C (In Series, Parallel and Series Parallel Combinations) with Sinusoidal Excitation- Resonance - Phasor diagrams - Concept of Power Factor- Concept of Reactance, Impedance, Susceptance and Admittance-Apparent Power, Active and Reactive Power, Examples.
Learning Outcomes: At the end of this unit, students should be able to
- Understand fundamental definitions of 1-ϕ AC circuits (L2)
- Distinguish between scalar, vector and phasor quantities (L2)
- Understand voltage, current and power relationships in 1-ϕ AC circuits with basic elements R, L, and C. (L2)
- Understand the basic definitions of complex immittances and complex power (L2)
- Solve 1-ϕ AC circuits with series and parallel combinations of electrical circuit elements R, L and C. (L2)

UNIT- IV (12 Hours)

Network Theorems: Superposition, Reciprocity, Thevenin's, Norton's, Maximum Power Transfer, Millmann's, Tellegen's, and Compensation Theorems for D.C and Sinusoidal Excitations.

Learning Outcomes: At the end of this unit, students should be able to

- Know that electrical circuits are 'heart' of electrical engineering subjects and network theorems are main part of it. (L2)
- Distinguish between various theorems and inter-relationship between various theorems (L2)
- Know about applications of certain theorems to DC circuit analysis (L2)
- Know about applications of certain theorems to AC network analysis (L2)
- Know about applications of certain theorems to both DC and AC network analysis (L2)

UNIT- V (12 Hours)

Three Phase A.C. Circuits: Introduction - Analysis of Balanced Three Phase Circuits – Phase Sequence- Star and Delta Connection - Relation between Line and Phase Voltages and Currents in Balanced Systems - Measurement of Active and Reactive Power in Balanced and Unbalanced Three Phase Systems. Analysis of Three Phase Unbalanced Circuits - Loop Method - Star Delta Transformation Technique – for balanced and unbalanced circuits - Measurement of Active and reactive Power – Advantages of Three Phase System.

Learning Outcomes: At the end of this unit, students should be able to

- Know about advantages of 3-ϕ circuits over 1-ϕ circuits (L2)
- Distinguish between balanced and unbalanced circuits (L2)
- Know about phasor relationships of voltage, current, power in star and delta connected balanced and unbalanced loads(L2)
- Know about measurement of active, reactive powers in balanced circuits (L2)
- Understand about analysis of unbalanced circuits and power calculations (L2)

TEXTBOOKS:

1. "Fundamentals of Electric Circuits", Charles K. Alexander and Matthew. N. O. Sadiku, Mc Graw Hill, 5th Edition, 2013.
2. "Engineering circuit analysis", William Hayt and Jack E. Kemmerly, Mc Graw Hill Company, 7th Edition, 2006.

REFERENCE BOOKS:

1. "Circuit Theory Analysis & Synthesis", A. Chakrabarti, Dhanpat Rai & Sons, 7th Revised Edition, 2018.
2. "Network Analysis", M.E Van Valkenberg, Prentice Hall (India), 3rd Edition, 1999.

3. “Electrical Engineering Fundamentals”, V. Del Toro, Prentice Hall International, 2nd Edition, 2019.
4. “Electric Circuits- Schaum’s Series”, Mc Graw Hill, 5th Edition, 2010.
5. “Electrical Circuit Theory and Technology”, John Bird, Routledge, Taylor & Francis, 5th Edition, 2014.

Course Code	C-PROGRAMMING & DATA STRUCTURES (Common to all branches)		L	T	P	C
21A050302			**3**	**0**	**0**	**3**
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Introduce the Concept of Algorithm and use it to solve computational problems
- To illustrate the basic concepts of C Programming language
- Demonstrate the use of Control structures of C Programming language
- To discuss the concepts of Arrays, Functions, Pointers and Structures
- To familiarize with Stack, Queue and Linked lists data structures

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Solve computational problems, choose appropriate control structure depending on the problem to be solved.

CO2: Design applications in C using Arrays and Strings.

CO3: Modularize the problem and also solution.

CO4: Design applications in C using Functions, Pointers, and Structures.

CO5: Explore various operations on Stacks, Queues and Linked lists.

CO-PO MAPPING:

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

UNIT-I (15 Hrs)

Computer Fundamentals, Algorithm, Flowchart.

Introduction to C Language: Characteristics, Identifiers, Constants, Data types, Keywords, Basic input/output statements, Structure of a C program.

Operators and Expressions: Operators classification, Assignment Operator, Arithmetic Operators, Relational and Logical Operators, Increment and Decrement Operators, Conditional Operator, Bitwise Operators with examples – Operator precedence and Associativity, Type casting.

Statements: Simple and Compound statements, Control Statements - Conditional/Decision statements, Loop Control Statements, Branch Control statements.

Learning Outcomes: At the end of this unit, students should be able to

- Solve complex problems using language independent notations (L3)
- Use C basic concepts to write simple C programs (L3)
- Test and execute the programs and correct syntax and logical errors (L4)
- Select the control structure for solving the problem (L4)
- Implement conditional branching, iterations (L2)

UNIT-II (12 Hrs)

Arrays: Declarations, Initialization and accessing elements, Single, Two and Multi-dimensional arrays.

Array Techniques: Array order reversal, finding the maximum and minimum number in a set, sorting the given array elements.

Strings: String I/O functions, String handling functions, Data conversion functions.

Learning Outcomes*:* At the end of this unit, students should be able to

- Use arrays to process multiple homogeneous data (L3)
- Solve mathematical problems using C Programming languages (L3)
- Apply string handling functions (L3)

UNIT-III (12 Hrs)

Functions: Types of functions, Library functions, User-defined functions, Function Categories, Nested functions, Recursion, Symbolic constants, Pre-processor Commands, Storage classes – auto, register, static, extern, Type qualifiers.

Input and output: Standard input and output, Non-formatted Input and Output statements, Formatted Input and Output statements.

Learning Outcomes*:* At the end of this unit, students should be able to

- Understand basic terminology of modular programming (L2)
- Apply modular approach for solving the problem (L3)
- Writing C programs using various storage classes to control variable access (L5)
- Apply input and output statements to process the data in various formats (L3)

UNIT-IV (12 Hrs)

Pointers: Pointers and addresses, Passing parameters to functions, Address Arithmetic operations, Void and Null pointers, Pointer and Arrays, Pointer and Strings, Array of Pointers, Pointer and Functions, Pointer-to-Pointer, Dynamic Memory Allocation. Uses of Pointers, Command line Arguments.

Structure and Union: Declaration and Initialization of a structure, Copy and comparisons, Array of structures, Structure with pointer, Nested structures, Type Definition, Enumeration, Union.

Learning Outcomes*:* At the end of this unit, students should be able to

- Structure the individual data elements to simplify the solutions (L6)
- Facilitate efficient memory utilization (L6)
- Use pointers and structures to formulate algorithm and write programs (L3)

UNIT-V (14 Hrs)

Data Structures: Overview of data structures, **Stack:** Representation of a stack, Operations and Applications of a Stack – Evaluation of Arithmetic Expressions, Implementation of Recursion – **Queue:** Representation of a queue, Operations and Applications of a Queue – CPU Scheduling in Multi-programming Environment.

Linked List: Representations of linked lists, singly linked list, doubly linked list, Circular linked list and its operations.

Learning Outcomes: At the end of this unit, students should be able to

- Describe the operations of a stack (L2)
- Develop various operations on Queues (L6)
- Analyze various operations on singly linked list (L4)
- Interpret operations of doubly linked lists (L2)
- Apply various operations on Circular linked lists (L6)

TEXTBOOKS:

1. "The Complete Reference C", Herbert Schildt, McGraw Hill Education, Fourth Edition
2. "Programming in C and Data Structures", J.R. Hanly, Ashok N Kamthane and A. Ananda Rao, Pearson Education.
3. "Fundamentals of Data Structures in C", Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Computer Science Press, Second Edition

REFERENCE BOOKS:

1. "The C Programming Language", Brain W Kernighan and Dennis M Ritchie, Prentice Hall Publication, Second Edition
2. "C and Data Structures", E Balaguruswamy, Tata McGraw Hill, Fourth Edition.
3. "Programming in C", Pradip Dey and Manas Ghosh, Oxford University Press, 2018.
4. "Schaum's Outline of Data Structures", Seymour Lipschutz, McGraw Hill, Revised First Edition.

Course Code	ENGINEERING DRAWING (Common to all branches)		L	T	P	C
21A030301			1	0	4	3
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- Bring awareness that Engineering Drawing is the Language of Engineers.
- Familiarize how industry communicates technical information.
- Teach the practices for accuracy and clarity in presenting the technical information.
- Develop the engineering imagination essential for successful design.
- Instruct the utility of drafting & modelling packages in orthographic and isometric drawings.
- Train the usage of 2D and 3D modelling.
- Instruct graphical representation of machine components.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Construction of various conic curves, Cycloid curves

CO2: Construction of projections of Points, Lines applied in engineering

CO3: Construction of projections of Planes.

CO4: Construction of projection of solids development of surfaces regular Solids.

CO5: Representation of Ortho and Isometric views of solids.

CO-PO MAPPING:

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

UNIT-I (12 Hrs)

Introduction to Engineering Drawing: Principles of Engineering Drawing and their Significance - Conventions in drawing-lettering - BIS conventions.

a) Conic sections including the rectangular hyperbola- general method only,

b) Cycloid, Epi-cycloid and Hypocycloid - general method only.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the significance of engineering drawing (L2)
- Know the conventions used in the engineering drawing (L1)
- Identify the curves obtained in different conic sections (L2)
- Draw different cycloidal curves. (L3)

UNIT– II (12 Hrs)

Projection of points, lines: Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, true angle made by line.

Learning Outcomes: At the end of this unit, students should be able to

- Know how to draw the projections of points, lines (L1)
- Find the true length of the lines. (L2)

UNIT-III (18 Hrs)

Projection of planes: Projections of regular plane inclined to both the planes and also draw the projections of different planes in Computerized drawing.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the procedure to draw projection of planes. (L2)
- Draw the projection of plane inclined to one plane and both the planes. (L3)
- Understand the different commands used in Computerized drawing to draw different planes. (L2)

UNIT- IV (15 Hrs)

Projections of solids: Projections of regular solids inclined to one or both planes by rotational method.

Development of Solids: Development of lateral Surfaces of Right Regular Solids(without section)-Prism, Cylinder, Pyramid, Cone.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the procedure to draw projection of solids. (L2)
- Draw the projection of solid inclined to one plane. (L3)
- Draw the projection of solids inclined to both the planes. (L3)

UNIT–V (18 Hrs)

Isometric and Orthographic Projections: Principles of isometric projection- Isometric Scale-Isometric Views- Conventions- Isometric Views of lines, Planes, Simple solids (cube, cylinder and cone). Conversion of Isometric Views to Orthographic Views. Drawing the Isometric views using Computerized drawing.

Learning Outcomes: At the end of this unit, students should be able to

- Learn the basics convectional representation of different projections (L1)
- Draw the Orthographic projection of simple solids. (L3)
- Draw the Isometric projection of simple solids. (L3)

TEXTBOOKS:

1. "Engineering Drawing", K. L. Narayana & P. Kannaiah, SciTech Publishers, Chennai, 3/e.
2. "Engineering Drawing + AutoCAD", K. Venugopal, V. Prabhu Raja, New Age Publishers.
3. "Engineering Drawing", N. D. Bhatt, Charotar Publishers, 53/e, 2016

REFERENCE BOOKS:

1. "Engineering Drawing", Dhanajay A Jolhe, Tata McGraw-Hill, Copy Right, 2009.
2. "Engineering Drawing", Basant Agarwal & C. M. Agarwal, Tata McGraw-Hill
3. "Engineering Drawing", Shah and Rana, Pearson Education, 2/e, 2009

Course Code	FUNDAMENTALS OF ELECTRICAL CIRCUITS LAB (Common to EEE & ECE)		L	T	P	C
21A020302			0	0	3	1.5
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To analyze the given network by applying mesh and nodal analysis
- Remember, understand and apply various theorems and verify practically.
- Understand and analyze active, reactive power measurements in three phase balanced circuits.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Design and verify the various Kirchhoff's laws

CO2: Understand the electrical circuits by using mesh and nodal analysis

CO3: Remember, understand and apply various theorems and verify practically.

CO4: Understand and analyze active, reactive power measurements in three phase balanced circuits.

CO5: Determine the active, reactive power measurements in three-phase balanced and unbalanced circuits

CO-PO MAPPING:

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

List of Experiments:

1. Verification of Kirchhoff's laws
2. Verification of Mesh and Nodal analysis
3. Verification of Thevenin's and Norton's Theorems
4. Verification of Superposition Theorem for average values
5. Maximum Power Transfer Theorem for DC circuits
6. Verification of Reciprocity, Millmann's Theorems for DC circuits
7. Determination of Self, Mutual Inductances and Coefficient of Coupling
8. Measurement of Active Power for Star Connected Balanced Loads
9. Measurement of Reactive Power for Star Connected Balanced Loads
10. Measurement of Active Power for Delta Connected Balanced Loads
11. Measurement of Reactive Power for Delta Connected Balanced Loads

Note: Any ten experiments should be performed from the above list of experiments

TEXTBOOKS:

1. "Fundamentals of Electric Circuits", Charles K. Alexander and Matthew. N. O. Sadiku, McGraw Hill, 5th Edition, 2013
2. "Engineering circuit analysis", William Hayt and Jack E. Kemmerly, McGraw Hill Company, 7th Edition, 2006

Course Code	C-PROGRAMMING & DATA STRUCTURES LAB (Common to all branches)		L	T	P	C
21A050303			0	0	3	1.5
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To get familiar with the basic concepts of C Programming
- To make the student solve problems, implement algorithms using C language
- To design programs using arrays, strings, pointers and structures
- To design Stack and Queue operations
- To apply different operations o linked lists

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Demonstrate the basic concepts of C programming language.
CO2: Select the right control structure for solving the problem.
CO3: Develop C programs using functions, arrays, structures and pointers.
CO4: Illustrate the concepts Stacks and Queues.
CO5: Design operations on Linked lists.

CO-PO MAPPING:

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

Week 1

a) Write a C program to swap the given two integer values without using temporary variable.

b) Write a C program to print the first ‘N’ Fibonacci sequence numbers.

Week 2

a) Write a C program to print reverse of a given integer value.

b) Write a C program to find the roots of a quadratic equation.

Week 3

Write a C program that use recursive functions.

i) GCD of given two values.

ii) Factorial of a given value.

Week 4

a) Write a C program to find both the largest and smallest number in a list of integers.

b) Write a C program to perform the following:

i) Addition of Two matrices ii) Multiplication of Two matrices

Week 5

a) Write a C program that displays the position or index in the string S where the string T begins or -1 if S doesn't contain T.

b) Write a C program to read a set of strings and sort them in alphabetical order.

Week 6

a) Write a C program to count number of alphabets, digits and special symbols of a given line.

b) Write a C program to check whether a given string is palindrome or not.

Week 7

Write a C program to demonstrate the difference between call-by-value and call-by-address mechanisms.

Week 8

Write a program to perform the operations addition, subtraction, multiplication of complex numbers.

Week 9

Write a C program that implement stack operations using arrays.

Week 10

a) Write a C program that implement linear queue operations using arrays.

b) Write a C program that implement circular queue operations using arrays.

Week 11

Write a C program that uses functions to perform the following operations on singly linked list.

i) Creation ii) Insertion iii) Deletion iv) Traversal

Week 12

Write a C program that uses functions to perform the following operations on doubly linked list.

i) Creation ii) Insertion iii) Deletion iv) Traversal

Week 13

Write a C program that uses functions to perform the following operations on circular linked list.

i) Creation ii) Insertion iii) Deletion iv) Traversal

TEXTBOOKS:

1. "Programming in C and Data Structures", J.R. Hanly, Ashok N Kamthane and A. Ananda Rao, Pearson Education.
2. "Computer Science: A Structured Programming Approach Using C", B.A. Forouzon and R.F. Gilberg, CENGAGE Learning, Third Edition, 2016.
3. "C and Data Structures", E Balaguruswamy, Tata McGraw Hill, Fourth Edition.
4. "Schaum's Outline of Data Structures", Seymour Lipschutz, McGraw Hill, Revised First Edition.

REFERENCE BOOKS:

1. "The C Programming Language", Brain W Kernighan and Dennis M Ritchie, Prentice Hall Publication, Second Edition,
2. "Fundamentals of Data Structures in C", Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Computer Science Press, Second Edition.
3. "Programming in C", Pradip Dey and Manas Ghosh, Oxford University Press, 2018.

Course Code	COMMUNICATIVE ENGLISH LAB		L	T	P	C
21A110201	(Common to all branches)		0	0	2	1
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To make students communicate their thoughts, opinions and ideas freely in real life situations.
- To improve the language proficiency of students in English with special emphasis on Listening and Speaking skills.
- To equip students with professional skills & soft skills, Develop communication skills in formal and informal situations
- To help students present themselves confidently during Group Discussions and Oral Presentations

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Use creativity in listening to formal and informal conversations.
CO2: Analyze the concepts of active listening and barriers to listening.
CO3: Communicate effectively in everyday life using right oral expressions.
CO4: Acquire the confidence to present themselves effectively during academic and professional presentations.
CO5: Acquire basic knowledge of non-verbal communication and its importance.

CO-PO MAPPING:

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

UNIT-I (6 Hrs)

Essentials of Listening: Purpose of Listening, Listening to Conversation (Formal and Informal), Active Listening- an Effective Listening Skill, Barriers to Listening, Listening to Announcements- (railway/ bus stations/ airport /sports announcement/commentaries etc.)

Learning Outcomes: At the end of this unit, students should be able to

- Know the difference between hearing and listening. (L2)
- Understand the purpose of active listening. (L2)
- Follow the announcements through focused listening. (L2)

UNIT-II (6 Hrs)

Listening Comprehension: Academic Listening (Listening to Lectures), Listening to Short Talks and Listening to Presentations, Note Taking Tips

Learning Outcomes: At the end of this unit, students should be able to

- Comprehend different academic lectures. (L3)
- Take notes while listening to short talks and lectures. (L3)
- Improve comprehension skills through listening to short talks and presentations. (L3)

UNIT-III (6 Hrs)

Communicating in everyday life: Asking for and giving information, Offering and responding to offers, Requesting and responding to requests, Congratulating people on their success, Expressing condolences, Asking questions and responding politely, Apologizing and forgiving,

Learning Outcomes: At the end of this unit, students should be able to

- Use appropriate expressions to communicate in everyday life. (L3)
- Communicate effectively in different contexts of conversations. (L3)
- Participate in role plays and situational dialogues with an exposure to social and professional contexts. (L3)

UNIT- IV (6 Hrs)

Presentation Skills: Giving Short Talks, Preparing power point presentation, Greeting and Introducing in presentations, Presenting a paper, Participating in group discussions (dos & don'ts)

Learning Outcomes: At the end of this unit, students should be able to

- Prepare a power point presentation effectively. (L3)
- Present a paper in a seminar. (L3)
- Participate in Group Discussions efficiently. (L3)

UNIT-V (6 Hrs)

Non-verbal Communication: Personal Appearance, Gestures, Postures, Facial Expression, Eye Contact, Body Language (Kinesics), Silence, Tips for Improving Non-Verbal Communication

Learning Outcomes: At the end of this unit, students should be able to

- Know the importance of body language in communication (L2)
- Improve non-verbal communication skills (L3)
- Understand how body language and non-verbal communication affects the personality of an individual in a social and professional set-up. (L2)

TEXTBOOKS:

1. "Technical Communication – Principles and Practice", Meenakshi Raman, Sangeeta Sharma, Oxford University Press

REFERENCE BOOKS:

1. "A Textbook of English Phonetics for Indian Students", T. Balasubramanian, Mc Millan India Pvt

2. "English Vocabulary in Use", Michael McCarthy, Cambridge University Press
3. "Strengthen your English", Bhaskaran, Horsburgh, Oxford University Press
4. "Practical English Usage", Michael Swan, Oxford University Press

ONLINE LEARNING RESOURCES:

1. https://learnenglish.britishcouncil.org/skills/listening
2. https://agendaweb.org/listening/comprehension-exercises.html
3. https://www.123listening.com/
4. https://www.linguahouse.com/learning-english/skill-4-learners/listening
5. https://www.talkenglish.com/listening/listen.aspx
6. https://ed.ted.co

Course Code	DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS (Common to CE, EEE & ECE)		L	T	P	C
21A110103			3	0	0	3
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Solve the differential equations related to various engineering fields.
CO2: Apply a range of techniques to find solutions of standard PDEs.
CO3: Identify solution methods for partial differential equations that model physical Processes.
CO4: Interpret the physical meaning of different operators such as gradient, curl and divergence.
CO5: Estimate the work done against a field, circulation and flux using vector calculus.

CO-PO MAPPING:

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

UNIT – I (13 Hrs)

Linear differential equations of higher order (Constant Coefficients): Definitions, homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskian method of variation of parameters. Simultaneous linear equations, Applications toL-C-R Circuit problems and Mass spring system.

Learning Outcomes: At the end of this unit, students should be able to

- Identify the essential characteristics of linear differential equations with constant coefficients (L3)
- Solve the linear differential equations with constant coefficients by appropriate method (L3)
- Classify and interpret the solutions of linear differential equations (L3)
- Formulate and solve the higher order differential equation by analysing physical situations (L3)

UNIT– II (11 Hrs)

Partial Differential Equations: Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order equations using Lagrange's method.

Learning Outcomes: At the end of this unit, students should be able to

- Apply a range of techniques to find solutions of standard PDEs (L3)
- Outline the basic properties of standard PDEs (L2)

UNIT – III (12 Hrs)

Applications of Partial Differential Equations: Classification of PDE, method of separation of variables for second order equations. Applications of Partial Differential Equations: One dimensional Wave equation, One dimensional Heat equation and Laplace's Equation.

Learning Outcomes: At the end of this unit, students should be able to

- Classify the PDE (L3)
- Learn the applications of PDEs (L2)

UNIT– IV (13 Hrs)

Vector differentiation: Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

Learning Outcomes: At the end of this unit, students should be able to

- Apply del to Scalar and vector point functions (L3)
- Illustrate the physical interpretation of Gradient, Divergence and Curl (L3)

UNIT – V (14 Hrs)

Vector integration: Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stroke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

Learning Outcomes: At the end of this unit, students should be able to

- Find the work done in moving a particle along the path over a force field (L4)
- Evaluate the rates of fluid flow along and across curves (L4)
- Apply Green's, Stokes and Divergence theorem in evaluation of double and triple integrals (L3)

TEXTBOOKS:

1. "Advanced Engineering Mathematics", Erwin Kreyszig, John Wiley & Sons,10/e, 2011.
2. "Higher Engineering Mathematics", B.S. Grewal, Khanna publishers, 44/e, 2017.

REFERENCE BOOKS:

1. "Engineering Mathematics", T. K. V Iyengar, Dr. B. Krishna Gandhi, S. Ranganatham, M.V.S.S.N Prasad, S. Chand Publications
2. "Advanced Engineering Mathematics", Michael Greenberg, Pearson, 2/e, 2018
3. "Calculus", George B. Thomas, Maurice D. Weir and Joel Hass, Thomas, Pearson Publishers, 13/e, 2013.
4. "Advanced Engineering Mathematics", R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 3/e, 2002.
5. "Advanced Modern Engineering Mathematics", Glyn James, Pearson publishers, 4/e, 2011.
6. "Advanced Engineering Mathematics", Michael Greenberg, Pearson edn, 9th edition
7. "Advanced engineering mathematics with MATLAB", Dean G. Duffy, CRC Press
8. "Advanced Engineering Mathematics", Peter O'Neil, Cengage Learning.
9. "Engineering Mathematics Volumes-I &II", R.L. Garg Nishu Gupta, Pearson Education
10. "Higher Engineering Mathematics", B. V. Ramana, McGraw Hill Education.
11. "Higher Engineering Mathematics", H. K Das, Er. Rajnish Verma, S. Chand.
12. "Advanced Engineering Mathematics", N. Bali, M. Goyal, C. Watkins, Infinity Science Press.

Course Code	APPLIED PHYSICS		L	T	P	C
21A110104	(Common to EEE, ECE & CSE)		3	0	0	3
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To identify the importance of the physical optics i.e., interference, diffraction and polarization related to its engineering applications
- To understand the mechanisms of lasers and propagation of light through optical fibres along with engineering applications.
- To explain the significant concepts of dielectric and magnetic materials that leads to potential applications in the emerging microdevices.
- To present the basic concepts needed to understand the crystal structure of materials, X- ray diffraction and the importance of nano materials.
- Evolution of band theory to distinguish materials and explain the properties of semiconductors and superconductors.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Analyze the differences between interference, diffraction & polarization with applications.

CO2: Identify the importance of lasers and fiber optics in different engineering fields

CO3: Understand the response of dielectric & magnetic materials to the applied electric & magnetic fields

CO4: Explain the important properties of crystals & structure determination using X-ray diffraction along with the nano materials.

CO5: Elaborate the physical properties of semiconductors and superconductors

CO-PO MAPPING:

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

UNIT-I (13 Hrs)

Wave Optics Interference- Principle of superposition – Interference of light – Conditions for sustained interference - Interference in thin films (Reflection Geometry) – Colors in thin films – Newton's Rings – Determination of wavelength and refractive index.

Diffraction- Introduction – Fresnel and Fraunhofer diffraction – Fraunhofer diffraction due to single slit, double slit – Grating spectrum.

Polarization- Introduction – Types of polarization – Polarization by double refraction- Nicol's

Prism - Half wave and Quarter wave plates with applications.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the need of coherent sources and the conditions for sustained interference (L2)
- Identify engineering applications of interference (L3)
- Analyze the differences between interference and diffraction with applications (L4)
- Illustrate the concept of polarization of light and its applications (L2)
- Classify ordinary polarized light and extraordinary polarized light (L2)

<u>UNIT-II</u> (12 Hrs)

Lasers and Fiber optics

Lasers- Introduction – Characteristics of laser – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion – Lasing action – Pumping mechanisms – Nd-YAG laser – He-Ne laser – Applications of lasers.

Fiber optics- Introduction – Principle of optical fiber – Acceptance Angle – Numerical Aperture – Classification of optical fibers based on refractive index profile and modes – Transmission of Signals in Step index and graded index fiber – Propagation Losses (qualitative) – Block diagram of Fiber Optics Communication System- Applications of Fibers in medical field.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the basic concepts of LASER light Sources (L2)
- Apply the concepts to learn the types of lasers (L3)
- Identifies the Engineering applications of lasers (L2)
- Explain the working principle of optical fibers (L2)
- Classify optical fibers based on refractive index profile and mode of propagation (L2)
- Identify the applications of optical fibers in various fields (L2)

<u>UNIT-III</u> (12 Hrs)

Dielectric Materials- Introduction – Dielectric polarization – Dielectric polarizability, Susceptibility and Dielectric constant – Types of polarizations: Electronic, Ionic and Orientation polarizations (Qualitative) – Lorentz internal field – Clausius-Mossotti equation.

Magnetic Materials- Introduction – Magnetic dipole moment – Magnetization – Magnetic susceptibility and Permeability – Origin of permanent magnetic moment – Classification of magnetic materials: Dia, para & Ferro-Domain concept of Ferromagnetism (Qualitative) – Hysteresis – Soft and Hard magnetic materials.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the concept of dielectric constant and polarization in dielectric materials (L2)
- Summarize various types of polarization of dielectrics (L2)
- Interpret Lorentz field and Clausius- Mosotti relation in dielectrics (L2)
- Classify the magnetic materials based on susceptibility and their temperature dependence (L2)

- Explain the applications of dielectric and magnetic materials (L2)

UNIT-IV (12 Hrs)

Crystallography: Introduction – Space lattice –Unit cell – Lattice parameters –Bravias lattice – Crystal systems – Packing fractions of SC, BCC and FCC - Directions and planes in crystals – Miller indices – Interplanar spacing in cubic crystals – X-ray diffraction - Bragg's law – Laue method - Powder method.

Nano materials – Introduction – Surface area and quantum confinement – Physical properties: electrical and magnetic properties – Synthesis of nanomaterials: Top-down: Ball Milling – Bottom-up: Chemical Vapour Deposition – Applications of nano materials.

Learning Outcomes: At the end of this unit, students should be able to

- Classify various crystal systems (L2)
- Identify different planes in the crystal structure (L3)
- Analyze the crystalline structure by Bragg's law to measure the crystallinity of a solid by powder method (L4)
- Identify the nano size dependent properties of nanomaterials (L2)
- Illustrate the methods for the synthesis and characterization of nanomaterials (L2)
- Apply the basic properties of nanomaterials in various Engineering branches (L3)

UNIT- V (12 Hrs)

Semiconductors and Superconductors

Semiconductors- Origin of energy bands - Classification of solids into conductors, semiconductors and insulators -Intrinsic and extrinsic semiconductors (Qualitative treatment)– Density of carriers and Fermi levels in intrinsic & extrinsic semiconductors - Drift& diffusion currents and Einstein's equation – Hall effect - Direct and indirect band gap semiconductors.

Superconductors- Introduction – Properties of superconductors – Meissner effect – Type I and Type II superconductors – BCS theory – Josephson effects (AC and DC) – High T_c superconductors – Applications of superconductors.

Learning Outcomes: At the end of this unit, students should be able to

- Classify the energy bands of semiconductors (L2)
- Interpret the direct and indirect band gap semiconductors (L2)
- Identify the type of semiconductor using Hall effect (L2)
- Identify applications of semiconductors in electronic devices (L2)
- Explain how electrical resistivity of solids changes with temperature (L2)
- Classify superconductors based on Meissner's effect (L2)
- Explain Meissner's effect, BCS theory & Josephson effect in superconductors (L2)

TEXTBOOKS:

1. "Engineering Physics", Dr. M. N. Avadhanulu & Dr. P. G. Kshirsagar, S. Chand and Company
2. "Engineering Physics", B.K. Pandey and S. Chaturvedi, Cengage Learning.
3. "Engineering Physics", K. Thyagarajan, McGraw Hill Publishers

REFERENCE BOOKS:

1. "Engineering Physics", Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018
2. "Engineering Physics", Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press
3. "Semiconductor physics and devices - Basic principles", Donald A, Neamen, McGraw Hill
4. "Engineering physics", P.K. Palanisamy, SCITECH Publications
5. "Applied Physics", S. Mani Naidu, Pearson Publications
6. "Lasers and Non-Linear Optics", B.B Laud, New Age International Publishers.

Course Code	APPLIED CHEMISTRY (Common to EEE, ECE, CSE, CSE-AI, AIML, CSE-IOT)		L	T	P	C
21A110105			**3**	**0**	**0**	**3**
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To familiarize Applied chemistry and applications.
- To train the students on the principles and applications of electrochemistry and polymers.
- To introduce instrumental methods and applications.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain the salient features of different theories along with their applications.
CO2: Discuss about the model engineering materials.
CO3: Apply the knowledge of various electrodes for the development of new batteries.
CO4: Identify the different polymers and their uses in various fields of engineering.
CO5: Analyze the knowledge of different analytical techniques used in engineering and also development of new techniques.

CO-PO MAPPING:

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

UNIT-I (14 Hrs)

Structure and Bonding Models: Planck's quantum theory, dual nature of matter, Schrodinger equation, significance of Ψ and Ψ^2, Molecular orbital theory –bonding in homo and hetero nuclear diatomic molecules – energy level diagrams of O_2 and CO, π-molecular orbitals of butadiene and benzene, calculation of bond order. Crystal field theory–salient features–splitting in octahedral and tetrahedral geometry.

Learning Outcomes: At the end of this unit, students should be able to

- Illustrate the molecular orbital energy level diagram of different molecular species (L2)
- Discuss the basic concept of molecular orbital theory (L3)
- Explain the calculation of bond order of O_2 and CO molecules (L2)
- Discuss the salient features of Crystal field theory (L3)

UNIT-II (10 Hrs)

Modern Engineering Materials: Band theory of solids- band diagrams for conductors, Insulators, Semiconductors, Effect of doping on band structures.

Super conductors and Super capacitors: Introduction, Definition, Classification, Applications.

Nano chemistry: Introduction, classification of nano materials, properties and applications of Fullerenes, carbon nanotubes and Graphene nanoparticles.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the band theory of solids for conductors, semiconductors and insulators (L2)
- Demonstrate the application of Fullerenes, carbon nanotubes and Graphenes nanoparticles (L2).

UNIT-III (13 Hrs)

Electro Chemistry and Applications: Electrodes and their concepts, Types of Reference electrodes-their applications. Electrochemical cell, Nernst equation, Numerical problems on emf.

Primary cells – Zinc-air battery, Secondary cells – Lead-acid and Lithium-ion batteries-working of the batteries including cell reactions; Fuel cells- hydrogen-oxygen, methanol- oxygen fuel cells – working of the cells.

Potentiometry- principle, potentiometric titrations (redox titrations), Conductometry- conductometric titrations (acid-base titrations).

Electrochemical sensors– potentiometric sensors principle with examples, ampere metric sensors principle with examples and their applications.

Learning Outcomes: At the end of this unit, students should be able to

- Apply the Nernst equation for calculating electrode and cell potentials (L3)
- Differentiate between potentiometric and conductometric titrations (L2)
- Explain the theory of construction of battery and fuel cells (L2)

UNIT-IV (13 Hrs)

Polymer Chemistry: Introduction to polymers, functionality of monomers and their significance, Tacticity of polymers, Types of polymerization- chain growth, step growth and copolymerization with specific examples and mechanisms of polymer formation.

Plastomers-Thermoplastics and Thermo setting plastics, Preparation, properties and applications of– PVC, Teflon, Bakelite, Nylons.

Elastomers – Buna-S, Buna-N– preparation, properties and applications of Buna-S, Buna-N.

Conducting polymers, examples, classification, polyacetylene, polyaniline - mechanism of conduction and applications.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the different types of polymers and their applications (L2)
- Explain the preparation, properties and applications of Bakelite, Nylons (L2)
- Describe the mechanism of conduction in conducting polymers (L2)

- Discuss Buna-S and Buna-N and their applications (L2)

UNIT-V (10 Hrs)

Instrumental Methods and Applications: Introduction, Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law- Principle, instrumentation and applications of UV-Visible**,** IR-Spectroscopy's and pH-metry, Solid-Liquid Chromatography–TLC, retention factor.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the different types of spectral series in electromagnetic spectrum (L2)
- Understand the principles and applications of different analytical instruments (L2)

TEXTBOOKS:

1. "Engineering Chemistry", Jain and Jain, Dhanpat Rai publications, 17/e, 2018
2. "Engineering Chemistry", Shashi Chawla, Dhanpat Rai publications, 2/e, 2014
3. "Principles of Instrumental Analysis", Skoog, FJ Holler and SR Crouch, 7/e, 2018
4. "Applied Chemistry", Guesser, Springer's Publications, 2001
5. "Atkins' Physical Chemistry", Peter Atkins, Julio de Paula and James Keeler, Oxford University Press, 10/e, 2010

REFERENCE BOOKS:

1. "Concise Inorganic Chemistry", J. D. Lee, Oxford University Press, 5/e, 2008
2. "Engineering Chemistry", G. V. Subba Reddy, K. N. Jayaveera and Ramachandraiah, McGraw Hill, 2020.

Course Code	ENGLISH FOR PROFESSIONALS		L	T	P	C
21A110202	(Common to all branches)		2	0	0	2
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To improve Reading and Writing proficiency of students in English with an emphasis on Vocabulary development.
- To provide knowledge of grammatical structures and encourage their appropriate use in writing.
- To improve students' comprehension skills required for academic and professional needs.
- To equip students with writing skills required for professional correspondence in different contexts.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Demonstrate word knowledge and its usage in appropriate contexts.
CO2: Recognize and incorporate basic grammar mechanics and sentence variety in writing.
CO3: Improve comprehension skills through intensive and extensive reading practice.
CO4: Learn and apply various writing formats for effective communication.
CO5: Improve writing skills needed for professional correspondence in various contexts.

CO-PO MAPPING:

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

UNIT-I (10 Hrs)

Vocabulary Building: Introduction to affixes and base words, Prefixes and suffixes, Basic comparing and contrasting, Idioms and Phrases, One word substitutes, Words often confused, Synonyms and Antonyms used in the everyday contexts, Using prior knowledge to determine the correct word for the context, Discovering the correct word in the sentence by looking at the surrounding words, Vocabulary in social interactions.

Learning Outcomes: At the end of this unit, students should be able to

- Recognize word parts: affixes, prefixes, suffixes and base words. (L2)
- Use words appropriately in a context. (L3)
- Guess the meanings of the words by using the contextual clues. (L2)
- Use synonyms, antonyms, phrases and idioms in writing. (L2)

UNIT-II (10 Hrs)
Essentials of Sentence Formation: Basic Sentence Structure, word order, Subject-Verb Concord, Using Tenses, Punctuation Marks, Correction of Common Errors
Learning Outcomes: At the end of this unit, students should be able to

- Frame a sentence without any grammatical errors. (L3)
- Use appropriate punctuation marks. (L3)
- Identify common errors in a sentence. (L2)

UNIT-III (10 Hrs)
Reading Comprehension: Understanding short real-world notices, messages, factual material - Scanning, skimming - Inferring meaning - Critical reading - Reading and information transfer
Learning Outcomes: At the end of this unit, students should be able to

- Use skimming and scanning strategies while reading. (L3)
- Infer meaning from the given text. (L3)
- Distinguish between the main idea and supporting ideas. (L3)
- Critically analyse the given text. (L4)

UNIT-IV (10 Hrs)
Writing Skills: Rules for good writing and composition; Paragraph Writing: Structure of a paragraph, Types of paragraphs, Usage of Cohesive Devices; Essay writing: Structure of an Essay, Types of Essays; Letter Writing (Formal and informal): Format and Structure; and Email writing
Learning Outcomes: At the end of this unit, students should be able to

- Learn to organize thoughts into meaningful paragraphs. (L2)
- Use cohesive devices in making the piece of writing more coherent. (L3)
- Compose essays on different topics in a more organised structure. (L3)
- Draft letter and emails in a definite format. (L3)

UNIT-V (10 Hrs)
Professional Correspondence: Internal Correspondences – Memorandum, Note Taking, Minutes of Meetings; External Correspondences - Business Letters - Cover Letters - Sale Letters - Inquiry Letters - Complaint Letters - Emails & Netiquette
Learning Outcomes: At the end of this unit, students should be able to

- Draft official e-mails and letters for different professional purposes. (L3)
- Write proficiently memos and minutes of meeting. (L3)

TEXTBOOKS:

1. "Technical Communication – Principles and Practice", Meenakshi Raman, Sangeeta Sharma, Oxford University Press

REFERENCE BOOKS:

1. "A Textbook of English Phonetics for Indian Students", T. Balasubramanian, Mc Millan India Pvt
2. "English Vocabulary in Use", Michael McCarthy, Cambridge University Press
3. "Strengthen your English", Bhaskaran, Horsburgh, Oxford University Press
4. "Practical English Usage", Michael Swan, Oxford University Press

ONLINE LEARNING RESOURCES:

1. https://digital.library.upenn.edu/women/sultana/dream/dream.html
2. https://owl.purdue.edu/
3. https://www.thesaurus.com/
4. https://www.readwritethink.org/classroom-resources/student-interactives
5. https://www.fluentu.com/blog/english/english-writing-websites/

Course Code	ELECTRONIC DEVICES AND CIRCUITS (Common to EEE & ECE)		L	T	P	C
21A040301			3	0	0	3
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To introduce different types of semiconductor devices, viz., diodes and special diodes.
- To explain application of diodes as rectifiers, regulators, and voltage doubler.
- To describe operation and characteristics of Bipolar Junction Transistor& Field Effect transistors.
- To analyse the various biasing circuits using BJTs & FETs
- To analyse the BJT amplifiers using h parameter model.

COURSE OUTCOMES:

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

CO1: Describe basic operation and characteristics of various PN junction diodes.
CO2: Analyze diode circuits for different applications such as rectifiers with and without filters, regulators, and voltage doubler.
CO3: Explain principle, operation, and applications of BJT, FET & MOSFET.
CO4: Design various biasing circuits for BJT, FET & MOSFET.
CO5: Analyze BJT amplifiers using h parameter model.

CO-PO MAPPING:

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

UNIT-I (12 Hrs)

PN Junction Diode & Special Purpose Devices: Open circuited PN junction, operation, Current components in a PN diode, Diode Equation and its mathematical derivation, Volt-Ampere Characteristics, Energy band diagram of PN diode, Temperature dependence of Volt-Ampere Characteristics, Diode resistance (Static and Dynamic resistance), Diode capacitances (Transition and Diffusion capacitance).

V-I Characteristics of Zener diode, Avalanche breakdown and Zener breakdown. Principle of Operation, and Characteristics of Tunnel Diode, Varactor Diode, Schottky Barrier Diode, Silicon Control Rectifier & Uni-Junction Transistor (UJT), Semiconductor photo devices - LDR, LED, Photo diodes & Photo transistors.

Learning Outcomes: At the end of this unit, students should be able to

- Study the characteristics and operation of p-n junction diode and special diodes. (L1)
- Explain the energy band diagram & effect of temperature on the characteristics of diode. (L2)
- Derive the expression for transition capacitance and diffusion capacitance. (L2)

<u>UNIT-II</u> (10 Hrs)

Diode Applications: Diode as switch, Rectifier – Half wave and Full wave rectifier, Bridge rectifier, Ripple factor, PIV, Filters – Inductor and Capacitor Filter, L-section filter, pi-Filter, Zener as voltage regulator, Voltage doubler, Problem solving related to diode applications.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the circuit operation involving p-n junction and Zener diodes. (L2)
- Analyze the performance of rectifiers with and without filters. (L4)
- Design half wave and full wave rectifier circuits and voltage regulator. (L5)
- Compare the various rectifier circuits in terms of their parameter metrics. (L5)

<u>UNIT-III</u> (12 Hrs)

Transistor And FET Characteristics: Transistor construction, BJT Operation, BJT Symbol, Transistor as an Amplifier, Common Emitter, Common Base and Common Collector Configurations, Determination of h-Parameters from Transistor Characteristics, The Junction Field Effect Transistor (Construction, Principle of Operation, Symbol) - Pinch-Off Voltage – Volt-Ampere Characteristics, FET as Voltage Variable Resistor, Comparison between BJT and FET, MOSFET- Basic Concepts, Construction, modes(depletion & enhancement), symbol, principle of operation, characteristics.

Learning Outcomes: At the end of this unit, students should be able to

- Explain principle, operation, application of Bipolar Junction Transistor, FET and MOSFET. (L2)
- Describe input, output Characteristics of Bipolar Junction Transistor, FET and MOSFET. (L2)
- Analyze the different configurations (CB, CC, CE). (L4)

<u>UNIT-IV</u> (12 Hrs)

Biasing And Stabilization: Operating Point, DC and AC Load Lines, Importance of Biasing, Fixed Bias, Collector to Base Bias, Self-Bias, Bias Stability, Stabilization against Variations in I_{CO}, V_{BE} and β, Bias Compensation Using Diodes and Transistors, Thermal Runaway, Condition for Thermal Stability in CE configuration, Biasing of FET & MOSFET – self-bias, voltage divider bias, Illustrative problems.

Learning Outcomes: At the end of this unit, students should be able to

- Derive the expression for stability factor of various biasing circuits. (L3)
- Explain Thermal Stability and its condition. (L2)
- Design different biasing circuits of BJT,FET and MOSFET.(L5)

UNIT-V (14 Hrs)

Small Signal Analysis of BJT Amplifiers: BJT modelling using h-parameters, Analysis of CE, CB and CC configurations using h-Parameters, Comparison of CB, CE and CC configurations, Simplified Hybrid Model, Analysis of CE, CB and CC configurations using simplified Hybrid Model.

Learning Outcomes: At the end of this unit, students should be able to

- Analyse different configurations of BJT using h parameter model. (L4)
- Compare CB, CE and CC configurations. (L4)

TEXTBOOKS:

1. "Electronic Devices and Circuits", J.Millman and Christos. C. Halkias, Satyabrata, TMH Third edition, 2012.
2. "Electronic Devices and Circuits", K. Lalkishore, BSP, 2nd edition, 2005

REFERENCE BOOKS:

1. "Electronic Devices and Circuits," R.L. Boylestad and Louis Nashelsky, 9th Edition, Pearson, 2006.
2. "Electronic Devices and Circuits", B.P.Singh and Rekha Singh, PEARSON, 2nd Edition, 2013.
3. "Electronic Devices and Circuits", David A. Bell, Oxford University press, 5th Edition, 2008.
4. "Electronic Devices and Circuits", N.Salivahanan and N. Suresh Kumar, TMH ,3rd Edition, 2012.

Course Code	APPLIED PHYSICS LAB		L	T	P	C
21A110108A	(Common to EEE, ECE & CSE)		**0**	**0**	**3**	**1.5**
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- Understands the concepts of interference, diffraction, and their applications.
- Understand the role of optical fiber parameters in communication.
- Recognize the importance of energy gap in the study of conductivity in semiconductors
- Will recognize the applications of laser in finding the wavelength in diffraction studies

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Operate optical instruments like microscope and spectrometer.
CO2: Determine thickness of a hair/paper with the concept of interference.
CO3: Plot the intensity of the magnetic field of circular coil carrying current with distance.
CO4: Evaluate the acceptance angle of an optical fiber and numerical aperture.
CO5: Determine the resistivity of the given semiconductor using four probe method.

CO-PO MAPPING:

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

LIST OF EXPERIMENTS

1. Determine the thickness of the wire using wedge shape method
2. Determination of the radius of curvature of the lens by Newton's ring method
3. Determination of wavelength by plane diffraction grating method
4. Determination of wavelength of LASER light using diffraction grating.
5. Determination of numerical aperture and acceptance angle of a given optical fiber.
6. Magnetic field along the axis of a circular coil carrying current–Stewart Gee's method.
7. Determination of the resistivity of semiconductor by Four probe method.
8. Determination of particle size using LASER.
9. Study the variation of B versus H by magnetizing the magnetic material. (B-H curve)
10. Determination of Dispersive power of prism.

REFERENCE BOOKS:

1. "A Textbook of Practical Physics", S. Balasubramanian, M.N. Srinivasan, S Chand Publishers, 2017.
2. http://vlab.amrita.edu/index.php -Virtual Labs, Amrita University

Course Code	APPLIED CHEMISTRY LAB		L	T	P	C
21A110108B	(Common to EEE, ECE, CSE, CSE-AI, AIML, CSE-IOT)		0	0	3	1.5
Pre-requisite	NIL	Semester	I			

COURSE OBJECTIVES:

- To get familiar with the basic concepts of Chemistry
- To verify the fundamental concepts with experiments.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Distinguish different types of titrations in the volumetric analysis
CO2: Determine the cell constant and conductance of solutions
CO3: Measure the strength of an acid present in secondary batteries
CO4: Analyze the effect of absorbance of given sample solution on concentration by using colorimetry.
CO5: Prepare advanced polymer Bakelite materials.

CO-PO MAPPING:

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

LIST OF EXPERIMENTS

1. Preparation of Standard Oxalic acid solution
2. Determination of Strength of an acid in Lead- Acid battery
3. Estimation of Ferrous Iron by Dichrometry
4. Potentiometry - Determination of redox potentials and emfs
5. Conductometry - Determination of cell constant and conductance of solutions.
6. Conductometric titration of a) strong acid vs strong base b) weak acid vs strong base.
7. p^H-metric titration of a) strong acid vs strong base b) weak acid vs strong base.
8. Verification of the Beer-Lambert's Law and determination of strength of the given unknown solution.
9. Determination of the Retention factor of the sample by Thin Layer Chromatography (TLC).
10. Measurement of 10Dq by spectrophotometric method.
11. Preparation of Bakelite and measurement of its mechanical properties (strength)
12. Preparation of nanomaterials.

TEXTBOOKS:

1. "A Text Book on Experiments and Calculations in Engineering Chemistry", S. Chand Publications, 9/e, 2003.
2. "Engineering Chemistry", Shashi Chawla, Dhanpat Rai publications, 2/e, 2014.
3. "Experiments in Applied Chemistry", Dr. Sunita Rattan, S. K. Kataria & Sons Publishers of Engineering, 2/e, 2004.

REFERENCE BOOKS:

1. "Vogel's Text Book of Quantitative Chemical Analysis", Mendham J et.al, Pearson Education, 6/e, 2012.

Course Code	ENGINEERING & IT WORKSHOP LAB		L	T	P	C
21A050301	(Common to all branches)		0	0	3	1.5
Pre-requisite	NIL	Semester	II			

PART-A (ENGINEERING WORKSHOP)

COURSE OBJECTIVES:

- To familiarize the students with wood working, sheet metal operations, fitting and electrical house, Wiring and foundry skills.
- To provide technical training to the students on Word, Excel and Presentation.
- To make the students know about the internal parts of a computer.
- To learn how to use Internet facility for Browsing and Searching.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Apply wood working skills and build different parts with metal sheets in real world applications.

CO2: Apply fitting operations in various applications and Preparation of moulds and castings.

CO3: Apply different types of basic electric circuit connections.

CO4: Prepare documentation, spread sheets for calculations and slides for Presentation.

CO5: Identify Computer peripherals and its functions, Internet browsing to obtain the required information

CO-PO MAPPING:

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

LIST OF TOPICS:

Wood Working: Familiarity with different types of woods and tools used in wood working and make following joints

a) Half – Lap joint b) Dovetail joint or Bridle joint

Sheet Metal Working: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets

a) Tapered tray b) Conical funnel

Fitting: Familiarity with different types of tools used in fitting and do the following fitting exercises

a) V-fit b) Square fit.

Electrical Wiring: Familiarities with different types of basic electrical circuits and make the following connections
a) Parallel and series b) Two-way switch c) Godown lighting

Foundry:

a) Preparation of mould cavity using single piece pattern.
b) Preparation of mould cavity using split piece pattern

PART-B (IT WORKSHOP)

LIST OF TOPICS:

Task 1:

MS-Word: Students should be able to create documents using the word processor tool. Alignment of the lines, Inserting header and Footer, changing the font, changing the color, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Students should be able to prepare project cover pages, content sheet and chapter pages at the end of the task using the features studied. Students should submit report.

Task 2:

Spreadsheet: Students should be able to create, open, save the application documents and format them as per the requirement. Creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells. Students should submit a user manual of the Spreadsheet.

Task 3:

Presentations: creating, opening, saving the presentations, selecting the style for slides, formatting the slides with different fonts, colors, creating charts and tables, inserting and deleting text, graphics and animations, bulleting and numbering, running the slide show.

Task 4: Learn about Computer: Identify the internal parts of a computer, and its peripherals. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.

Task 5:

Browsing Internet: Student should access the Internet for Browsing. Students should search the Internet for required information. Students should be able to create e-mail account and send email.

REFERENCE BOOKS:

1. "Workshop Practice Manual", K. Venkata Reddy, BS Publications.
2. "Engineering work shop practice for JNTU", V. Ramesh babu, VRB Publishers Pvt. Ltd., 2009.
3. "Work shop manual", P. Kannaiah, K. L. Narayana, SCITECH Publishers.
4. "Engineering practices lab manual", Jeyapoovan, Saravanapandian, Vikas Publishing House, 4/E
5. "Dictionary of mechanical engineering", GHF Nayler, Jaico Publishing House.
6. "Introduction to Computers", Peter Norton, McGraw Hill
7. "MOS study guide for word, Excel, Power point & Outlook Exams", Joan Lambert, Joyce Cox.
8. "Introduction to Information Technology", ITL Education Solutions limited, Pearson Education.
9. "Networking your computers and devices", Rusen, Prentice Hall of India
10. "Bigelow's Trouble shooting, Maintaining & Repairing PCs", Bigelow, Tata McGraw Hill Edition

Course Code	ELECTRONIC DEVICES & CIRCUITS LAB		L	T	P	C
21A040302	(Common to EEE & ECE)		0	0	3	1.5
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To verify the theoretical concepts practically from all the experiments.
- To analyze the characteristics of diodes, UJT, BJT, FET, SCR.
- To design voltage divider biasing of BJT and JFET.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Compute the parameters of Diodes and Transistors from the characteristics.
CO2: Demonstrate the rectifier and voltage regulator circuits using diodes.
CO3: Analyze the Characteristics of UJT and SCR
CO4: Design biasing circuit of BJT and FET.

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. P-N Junction Diode Characteristics
   Part A: Germanium Diode (Forward bias & Reverse bias)
   Part B: Silicon Diode (Forward bias only)
2. Zener Diode Characteristics
   Part A: V-I Characteristics
   Part B: Zener Diode act as a Voltage Regulator
3. Rectifiers (without and with c-filter)
   Part A: Half-wave Rectifier
   Part B: Full-wave Rectifier
4. BJT Characteristics (CE Configuration)
   Part A: Input Characteristics
   Part B: Output Characteristics.
5. BJT Characteristics (CB Configuration)
   Part A: Input Characteristics
   Part B: Output Characteristics

6. FET Characteristics (CS Configuration)
   Part A: Drain (Output) Characteristics
   Part B: Transfer Characteristics
7. SCR Characteristics
8. UJT Characteristics
9. Transistor Biasing
10. FET Biasing.

Tools / Equipment Required:
Licensed simulation software /DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs and all the required active devices.

Note: The students are required to design the circuit and they have to perform the analysis through simulator using Pspice/Equivalent Licensed simulation software tool. Further they are required to verify the result using necessary hardware in the hardware laboratory.

Course Code	ENVIRONMENTAL SCIENCE		L	T	P	C
21A000001	(Common to CE, ME, EEE, ECE, CSE, CSE-IOT)		2	0	0	0
Pre-requisite	NIL	Semester	II			

COURSE OBJECTIVES:

- To make the students to get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day-to-day activities of human life
- To save earth from the inventions by the engineers.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Grasp multidisciplinary nature of environmental studies and various renewable and non-renewable resources.

CO2: Understand flow and bio-geo- chemical cycles and ecological pyramids.

CO3: Understand various causes of pollution and solid waste management and related preventive measures.

CO4: About the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation.

CO5: Casus of population explosion, value education and welfare programmes.

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Multidisciplinary Nature of Environmental Studies: Definition, Scope and Importance, Need for Public Awareness.

Natural Resources : Renewable and non-renewable resources – Natural resources and associatedproblems–Forestresources–Useandover–exploitation,deforestation,casestudies - Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

Learning Outcomes: At the end of this unit, students should be able to

- Know the importance of public awareness (L1)
- Know about the various resources (L1)

UNIT–II (10 Hrs)

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem.
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity And Its Conservation : Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Learning Outcomes: At the end of this unit, students should be able to

- Know about various echo systems and their characteristics (L1)
- Know about the biodiversity and its conservation (L1)

UNIT – III (10 Hrs)

Environmental Pollution: Definition, Cause, effects and control measures of:

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

Learning Outcomes: At the end of this unit, students should be able to

- Know about the various sources of pollution. (L1)
- Know about the various sources of solid waste and preventive measures. (L1)

- Know about the different types of disasters and their managerial measures. (L1)

UNIT- IV (10 Hrs)

Social Issues and The Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, water shed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

Learning Outcomes: At the end of this unit, students should be able to

- Know about the social issues related to environment and their protection acts. (L1)
- Know about the various sources of conservation of natural resources. (L1)
- Know about the wild life protection and forest conservation acts. (L1)

UNIT – V (10 Hrs)

Human Population and The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

Learning Outcomes: At the end of this unit, students should be able to

- Know about the population explosion and family welfare programmes. (L1)
- Identify the natural assets and related case studies. (L1)

TEXTBOOKS:

1. “Text book of Environmental Studies for Undergraduate Courses”, Erach Bharucha for University Grants Commission, Universities Press.
2. “Environmental Studies”, Palani swamy, Pearson education
3. “Environmental Studies”, S. Azeem Unnisa, Academic Publishing Company
4. “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, K. Raghavan Nambiar, SCITECH Publications (India), Pvt. Ltd.

REFERENCE BOOKS:

1. "Textbook of Environmental Science", Deeksha Dave and E. Sai Baba Reddy, Cengage Publications.
2. "Text book of Environmental Sciences and Technology", M. Anji Reddy, BS Publication.
3. "Comprehensive Environmental studies", J. P. Sharma, Laxmi publications.
4. "Environmental Sciences and Engineering", J. Glynn Henry and Gary W. Heinke, Prentice Hall of India Private limited
5. "A Text Book of Environmental Studies", G. R. Chatwal, Himalaya Publishing House
6. "Introduction to Environmental Engineering and Science", Gilbert M. Masters and Wendell P. Ela, Prentice Hall of India Private limited.

Course Code	COMPLEX VARIABLES & TRANSFORMS		L	T	P	C
21A110112	(Common to EEE & ECE)		3	0	0	3
Pre-requisite	Calculus and Special Functions, Differential Equations &Vector Calculus	Semester	III			

COURSE OBJECTIVES:

- This course aims at providing the student to acquire the knowledge on the calculus of functions of complex variables.
- To equip the students to solve various application problems in engineering through evaluation of continuous/discrete transforms.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand functions of Complex variable and its properties, and find derivatives of complex functions, analyticity of complex functions.

CO2: Apply Cauchy's integral theorem and Cauchy's integral formula, integration of complex functions using Residue theorem.

CO3: Analyze the concept Laplace and Inverse Laplace Transforms to solve Differential equations.

CO4: Determine the process of finding Fourier series expression of the given function, Fourier coefficients (Euler's) and expansion of Half range series.

CO5: Identify the applications of Fourier integrals, properties of Fourier Transforms. Analyze the concept of Z transforms and its properties.

CO-PO MAPPING:

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

UNIT – I (12 Hrs)

Complex Variable – Differentiation: Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations, analytic functions (exponential, trigonometric, logarithm), harmonic functions, finding harmonic conjugate-construction of analytic function by Milne Thomson method - Conformal mappings-standard and special transformations (sin z, e^z, cos z, z^2) Mobius transformations (bilinear) and their properties.

Learning outcomes: At the end of this unit, students should be able to

- Understand functions of Complex variable and its properties. (L2)
- Find derivatives of complex functions. (L3)
- Understand the analyticity of complex functions. (L2)

- Understand the conformal mappings of complex functions (L2)

UNIT- II (12 Hrs)

Complex Variable – Integration: Line Integral-Contour integration, Cauchy's integral theorem, Cauchy Integral formula, Liouville's theorem (without proof) and Maximum-Modulus theorem (without proof); power series expansions: Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).

Learning outcomes: At the end of this unit, students should be able to

- Understand the integration of complex functions. (L2)
- Apply Cauchy's integral theorem and Cauchy's integral formula. (L3)
- Understand singularities of complex functions. (L2)
- Evaluate improper integrals of complex functions using Residue theorem. (L4)

UNIT – III (12 Hrs)

Laplace Transforms: Definition-Laplace transform –Inverse Laplace Transform - standard functions - existence of Laplace Transform -shifting theorem's- Transforms of derivatives and integrals - Laplace transform of periodic function (without proof) - Unit step function - Dirac's delta function. –Convolution theorem – Differentiation and Integration of Transform- Solving Initial value problems to ordinary differential equations with constant coefficients using Laplace transforms.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of Laplace transforms and Inverse Laplace transforms of Elementary functions. (L2)
- Understand Laplace transforms of special functions (Unit step function, Unit Impulse & Periodic). (L2)
- Apply Laplace transforms to solve Differential Equations (L4)

UNIT – IV (11 Hrs)

Fourier Series: Determination of Fourier coefficients (Euler's) – Dirichlet conditions for the existence of Fourier series – functions having discontinuity-Fourier series of Even and odd functions – Fourier series in an arbitrary interval – Half-range Fourier sine and cosine expansions- typical wave forms -Parseval's formula- Complex form of Fourier series.

Learning outcomes: At the end of this unit, students should be able to

- Understand finding Fourier series expression of the given function. (L2)
- Determine Fourier coefficients (Euler's) and identify existence of Fourier series of the given function. (L3)
- Expand the given function in Fourier series given in Half range interval. (L2)
- Apply Fourier series to establish Identities among Euler coefficients. (L3)

UNIT – V (10 Hrs)

Fourier Transforms & Z Transforms: Fourier integral theorem (without proof) – Fourier sine and cosine integrals-complex form of Fourier integral. Fourier transform – Fourier sine and cosine transforms – Properties – Inverse transforms – convolution theorem.

Z-transform – Inverse z-transform – Properties – Damping rule – Shifting rule – Initial and final value theorems. Convolution theorem – Solution of difference equations by Z-transforms.

Learning outcomes: At the end of this unit, students should be able to

- Find Fourier Sine and cosine integrals. (L3)
- Understand Fourier and Z transforms. (L2)
- Apply properties of Fourier and Z transforms (L3)
- Apply Z transforms to solve difference equations. (L3)

TEXTBOOKS:

1. "Higher Engineering Mathematics", B. S. Grewal, Khanna publishers.
2. "Advanced Engineering Mathematics", Erwin Kreyszig, Wiley India

REFERENCE BOOKS:

1. "Higher Engineering Mathematics", B. V. Ramana, Mc Graw Hill publishers.
2. "Advanced Engineering Mathematics", Alan Jeffrey, Elsevier.
3. "An Introduction to Ordinary Differential Equations", E. A. Coddington, Prentice Hall India, 1995.
4. "A text book of Engineering Mathematics", N.P. Bali and Manish Goyal, Laxmi Publications, 2008.

Course Code	SIGNALS AND SYSTEMS		L	T	P	C
21A040401			3	0	0	3
Pre-requisite	Calculus and Special Functions, Mathematical Methods	Semester	III			

COURSE OBJECTIVES:

- To introduce students to the basic idea of signal and system analysis and its characterization in time and frequency domains.
- To present Fourier tools through the analogy between vectors and signals
- To describe the concepts of sampling and reconstruction of signals
- To describe the characteristics of linear systems in time and frequency domains.
- To understand Laplace and Z-transforms as mathematical tool to analyze continuous and discrete-time signals and systems

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Apply Fourier series to analyze periodic signals and their spectra.

CO2: Analyze continuous time signals using Fourier transform and illustrate signal sampling and its reconstruction

CO3: Analyze discrete time signals using discrete time Fourier transform

CO4: Examine signal transmission through linear systems

CO5: Apply Laplace and Z- transform to analyze continuous and discrete time systems

CO-PO MAPPING:

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

UNIT – I (11 Hrs)

Signals & Systems: Basic definitions and classification of Signals and Systems (Continuous time and discrete time), operations on signals, Concepts of Convolution and Correlation of signals, Analogy between vectors and signals-Orthogonality, mean square error, Fourier series: Trigonometric & Exponential, Properties of Fourier series, concept of discrete spectrum, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand different types of signals and systems. (L2)
- State principles of vector spaces and concept of Orthogonality (L2)

- Describe continuous time signal and discrete time signal. (L2)
- Analyse the periodic signals by applying Fourier series. (L3)

<u>UNIT – II</u> (12 Hrs)
Continuous Time Fourier Transform: Definition, Computation and properties of Fourier transform for different types of signals and systems, Inverse Fourier transform. Statement and proof of sampling theorem of low pass signals, Illustrative Problems.
Learning Outcomes: At the end of this unit, students should be able to

- Identify system properties based on impulse response and Fourier analysis. (L1)
- Analyze the spectral characteristics of signals. (L4)
- Illustrate signal sampling and its reconstruction. (L3)
- Apply Fourier transform to solve problems. (L3)

<u>UNIT – III</u> (12 Hrs)
Discrete Time Fourier Transform: Definition, Computation and properties of Discrete Time Fourier transform for different types of signals and systems, Illustrative Problems.
Learning Outcomes: At the end of this unit, students should be able to

- Understand the properties of the discrete-time Fourier transform. (L2)
- Analyse the spectral characteristics of signals using Fourier transform. (L4)
- Evaluate the Fourier transform of Discrete-time signals. (L4)

<u>UNIT – IV</u> (11 Hrs)
Signal Transmission Through Linear Systems: Linear system, impulse response, Response of a linear system for different input signals, linear time-invariant (LTI) system, linear time variant (LTV) system, Transfer function of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between bandwidth and rise time, Energy and Power spectral densities, Illustrative Problems
Learning Outcomes: At the end of this unit, students should be able to

- Understand the impulse response, transfer characteristics of LTI system and various filters. (L2)
- Analyse filter characteristics and physical realisation of LTI system. (L4)
- Apply the relation between bandwidth and rise time & energy and power spectral densities in various applications. (L3)

<u>UNIT – V</u> (10 Hrs)

Laplace Transform: Definition, ROC, Properties, Inverse Laplace transforms, the S-plane and BIBO stability, Transfer functions, System Response to standard signals, Solution of differential equations with initial conditions.

Z–Transform: Definition, ROC, Properties, Poles and Zeros in Z-plane, The inverse Z-Transform, System analysis, Transfer function, BIBO stability, System Response to standard signals, Solution of difference equations with initial conditions, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the limitations of Fourier transform and need for Laplace transform and develop (L2)
- Apply transform techniques to analyse discrete-time signals and systems. (L3)
- Evaluate response of linear systems to known inputs by using Laplace transforms. (L4)
- Analyze the continuous-time and discrete-time signals and systems using Laplace and Z-transforms. (L4)

<u>TEXTBOOKS:</u>

1. “Signals and Systems”, A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edition, 2009.
2. “Linear Systems and Signals”, B. P. Lathi, Oxford University press, Second Edition

<u>REFERENCE BOOKS:</u>

1. “Fundamentals of Signals and Systems”, Michel J. Robert, MGH International Edition, 2008.
2. “Schaum's Outline of Signals and Systems”, Hwei Hsu, TMH, 4th Edition, 2019.
3. “Signals & Systems”, Simon Haykin and Van Veen, Wiley, 2nd Edition, 2005
4. “Signals, Systems and Transforms”, C. L. Philips, J. M. Parr and Eve A. Riskin, Pearson education

Course Code	PULSE AND DIGITAL CIRCUITS		L	T	P	C
21A040402			3	0	0	3
Pre-requisite	Electronic Devices & Circuits	Semester	III			

COURSE OBJECTIVES:

- To design low pass and high pass circuit RC networks.
- To design clippers and clampers.
- To analyse various multivibrators and sweep circuits.
- To understand the significance of number systems, conversions, binary codes and functionality of logic gates and logic families.
- To discuss different simplification methods for minimizing Boolean functions.

COURSE OUTCOMES:

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

CO1: Design Low pass and High pass circuit RC networks.
CO2: Design diode Clipper and Clamper circuits.
CO3: Analyze various Multivibrators and Sweep circuits.
CO4: Utilize Boolean algebra, Number systems and Logic gates in the development of logic circuits.
CO5: Apply K-Map & Tabular methods to minimize logic functions.

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Linear Wave shaping: High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square and ramp inputs. High Pass RC network as Differentiator, Low Pass RC network as integrator, attenuators, and its applications as a CRO probe, RL and RLC circuits and their response for step input, Ringing circuit. Problem solving.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the basic working of Low pass and High pass circuits. (L2)
- Design different linear wave shaping circuits. (L5)

UNIT – II (10 Hrs)

Non-Linear Wave Shaping: Diode clippers, Transistor clippers, clipping at two independent levels, Comparators, applications of voltage comparators, clamping operation, clamping circuits taking source and Diode resistances into account, clamping circuit theorem, practical clamping circuits, Effect of diode characteristics on clamping voltage, Synchronized Clamping.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the basic working of Clippers and Clampers. (L2)
- Design different diode clippers and clamper. (L5)

UNIT – III (12 Hrs)

Multivibrator Circuits: Analysis and Design of Bistable, Monostable, Astable multivibrators and Schmitt trigger circuit using BJT. General features of a time base signal, methods of generating time base waveform, Miller and Bootstrap time base generators.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the principle of operation of the multivibrators. (L2)
- Analyse and Design of Multi-vibrator circuits and their applications. (L4)
- Understand Time-base generators. (L2)

UNIT – IV (14 Hrs)

Number System & Boolean Algebra: Decimal, Binary, Octal, and Hexa-decimal number systems and their conversions, complements of numbers, Signed binary numbers, Binary codes. Boolean Algebra-Basic definition, Basic theorems and properties, Boolean Functions, Canonical & Standard forms, other logic operations, Logic gates, Logic families (RTL, DTL, TTL, Schottky TTL, ECL and MOS) and Comparison.

Learning Outcomes: At the end of this unit, students should be able to

- Summarize advantages of using different number systems. (L2)
- Explain usefulness of different coding schemes. (L2)
- Understand the functionality of logic gates and Logic families. (L2)

UNIT – V (13 Hrs)

Gate Level Minimization: The map method, four variable, K-map, Five variable map, POS & SOP Simplification, Don't care conditions, NAND & NOR Implementation, Other two-level Implementation, Ex-or Function, Tabular Method- Simplification of Boolean function using tabulation Method.

Learning Outcomes: At the end of this unit, students should be able to

- Apply basic laws and De Morgan's theorems to simplify Boolean expressions. (L3)
- Compare K- Map and Q-M methods of minimizing logic functions. (L5)

TEXTBOOKS:

1. "Millman's Pulse, Digital and Switching Waveforms", J. Millman, H. Taub and Mothiki S. Prakash Rao, TMH, 2nd Edition, 2008.
2. "Solid State Pulse Circuits", David A. Bell, PHI, 4th edition, 2002.

3. "Digital Design", M.Morris Mano & Michel D. Ciletti, Pearson ,5th Edition.
4. "Switching theory and Finite Automata Theory", Zvi Kohavi and Nirah K. Jha, Cambridge, 3rd Edition

REFERENCE BOOKS:

1. "Pulse and Digital Circuits", A. Anand Kumar, PHI, 2005.
2. "Fundamentals of Pulse and Digital Circuits", Ronald J. Tocci, 3rd edition, 2008.
3. "Digital Electronics", Subratha Goshal, Cambridge.
4. "Digital & State Machine Design", Comer, OXFORD, Third Indian edition.

Course Code	PROBABILITY THEORY AND STOCHASTIC PROCESSES		L	T	P	C
21A040403			**3**	**0**	**0**	**3**
Pre-requisite	Calculus and Special Functions	Semester	III			

COURSE OBJECTIVES:

- To gain the knowledge of the basic probability concepts.
- To acquire skills in handling situations involving more than one random variable and functions of random variables.
- To gain knowledge of standard distributions that can describe real life phenomena.
- Make the difference between time averages and statistical averages.
- To understand the principles of random signals and random processes.
- To be acquainted with systems involving random signals.

COURSE OUTCOMES:

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

CO1: Understanding the concepts of Probability, Random Variables, Random Processes and their characteristics learn how to deal with multiple random variables, conditional probability, joint distribution and statistical independence.

CO2: Formulate and solve the engineering problems involving random variables and random processes.

CO3: Analyze the concepts and its properties of auto-correlation, cross-correlation functions and power spectral density of Random Process.

CO4: Analyze various probability density functions of random variables.

CO5: Derive the response of linear system for Gaussian noise and random signals as inputs.

CO-PO MAPPING:

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

UNIT – I (11 Hrs)

Probability Introduced Through Sets and Relative Frequency: Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem, Independent Events, Problem Solving.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the fundamental concepts of probability theory and conditional probability (L2)

<u>UNIT – II</u> (15 Hrs)

Random Variable: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous, Mixed Random Variable, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Methods of defining Conditioning Event, Conditional Density, Properties, Problem Solving.

Operations on Single Random Variable: Introduction, Expectation of a random variable, moments-moments about the origin, Central moments, Variance and Skew, Chebyshev's inequality, moment generating function, characteristic function, transformations of random variable.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the fundamental concepts of random variables. (L2)
- Evaluate the different probability distribution and density functions. (L4)
- Apply the knowledge to the central limit theorem in communication system. (3)
- Evaluate the single random variable concepts to expectation, variance and moments. (L4)

<u>UNIT – III</u> (12 Hrs)

Multiple Random Variables: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Interval conditioning, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem, (Proof not expected), Unequal Distribution, Equal Distributions.

Operations on Multiple Random Variables: Expected Value of a Function of Random Variables, Joint Moments of the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case, Properties of Gaussian random variables, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

Learning Outcomes: At the end of this unit, students should be able to

- Apply the knowledge to the sum of random variables in communication system. (L3)
- Evaluate the multiple random variable concepts to expectation, variance and moments. (L4)
- Apply the different operations to multiple random variables. (L3)
- Understand the concepts of linear transformation of Gaussian random variables. (L2)

UNIT – IV (13 Hrs)

Random Processes-Temporal Characteristics: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence, First-Order Stationary Processes, Second Order and Wide-Sense Stationarity, N-Order and Strict-Sense Stationarity. Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function and Its Properties, Cross-Correlation Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.

Random Processes-Spectral Characteristics: The Power Density Spectrum and its Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum and its Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function.

Learning Outcomes: At the end of this unit, students should be able to

- Understand and analyze continuous and discrete-time random processes. (L2)
- Analyze the concepts and its properties of auto correlation, cross correlation functions and power spectral density. (L4)

UNIT – V (11 Hrs)

Random Signal Response of Linear Systems: System Response – Convolution, Mean and Mean squared Value of System Response, autocorrelation Function of Response, Cross Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output, Band pass, Band Limited and Narrowband Processes, Properties.

Noise Definitions: White Noise, colored noise and their statistical characteristics, Ideal low pass filtered white noise, RC filtered white noise.

Learning Outcomes: At the end of this unit, students should be able to

- Describe the theory of stochastic processes to analyze linear systems. (L2)
- Apply the knowledge to linear systems; low pass and band pass noise models for random processes. (L3)

TEXTBOOKS:

1. "Probability, Random Variables & Random Signal Principles", Peyton Z. Peebles, TMH, 4th Edition, 2002.
2. "Probability, Random Variables and Stochastic Processes", Athanasios Papoulis and S. Unnikrishna Pillai, PHI, 4th Edition, 2002.

REFERENCE BOOKS:

1. "Communication Systems", Simon Haykin, Wiley, 3rd Edition, 2010.

2. "Probability and Random Processes with Application to Signal Processing," Henry Stark and John W. Woods, Pearson Education, 3rd Edition, 2002.
3. "Probability Methods of Signal and System Analysis, George R. Cooper, Clave D. MC Gillem, Oxford, 3rd Edition, 1999.

Course Code	ELECTRICAL TECHNOLOGY		L	T	P	C
21A020305			3	0	0	3
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- The constructional features of DC machines, different types of DC machines and their characteristic.
- The constructional details of single-phase transformer and their performance characteristics by conducting suitable tests.
- The analysis of three phases balanced and unbalanced circuits, three phase induction motors and their characteristics.
- The constructional feature and operation of synchronous machines.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Calculate the e.m.f. generated on DC Generator and analyzes the types of generators.
CO2: Analyze the various speed control techniques of DC motors.
CO3: Conduct open circuit and short circuit tests on single phase transformer for knowing their characteristics.
CO4: Analyze three phase circuits, three induction motor operating principle and know their torque slip characteristics.
CO5: Acquire knowledge on synchronous machine with which he/she can able to apply the above conceptual things to real-world problems and applications.

CO-PO MAPPING:

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

UNIT – I (10Hrs)

DC Generators: D.C. Generators – Principle of Operation – Constructional Features – E. M.F Equation–Numerical Problems – Methods of Excitation – Separately Excited and Self Excited Generators – Build-Up of E.M.F - Critical Field Resistance and Critical Speed - Load Characteristics of Shunt, Series and Compound Generators- Applications

Learning Outcomes: At the end of this unit, students should be able to

- Know about principle of operation of a DC machine working as a generator (L2)
- Distinguish between self and separately excited generators and classification (L4)

- Know how emf is developed (L4)
- Distinguish between critical field resistance and critical speed (L4)
- Know about various characteristics of different types of generators (L4)

UNIT – II (10Hrs)
D.C. Motors: D.C Motors – Principle of Operation – Back E.M.F. –Torque Equation – Characteristics and Application of Shunt, Series and Compound Motors-Speed Control of D.C. Motors: Armature Voltage and Field Flux Control Methods. Three Point Starter-Losses – Constant & Variable Losses – Calculation of Efficiency - Swinburne's Test.
Learning Outcomes: At the end of this unit, students should be able to

- Know about principle of operation of DC machine working as a motor (L2)
- Know about torque developed (L4)
- Know about how to control speed of DC shunt motor (L3)
- Know about necessity of starter (L2)
- Know about various load characteristics of various types of DC motors (L3)

UNIT – III (10Hrs)
Single Phase Transformers & Three Phase A.C. Circuits: Introduction - Single Phase Transformers- Constructional Details- Emf Equation - Operation on No Load and on Load - Phasor Diagrams-Equivalent Circuit - Losses and Efficiency-Regulation- OC and SC Tests - Predetermination of Efficiency and Regulation. Analysis of Balanced Three Phase Circuits – Phase Sequence- Star and Delta Connection - Relation between Line and Phase Voltages and Currents in Balanced Systems - Measurement of Active and Reactive Power in Balanced and Unbalanced Three Phase Systems.
Learning Outcomes: At the end of this unit, students should be able to

- Understand the principle of operation of 1-ϕ transformer (L2)
- Understand computation and predetermination of regulation of a 1-ϕ transformer (L2)
- Know about basics of three phase circuits (L2)
- Distinguish between phase voltages, currents, line values and phase values (L4)
- Distinguish between balanced and unbalanced three phase circuits and power Measurement (L4)

UNIT – IV (10Hrs)
3-Phase Induction Motors: Poly phase Induction Motors-Construction Details of Cage and Wound Rotor Machines-- Principle of Operation – Slip- Rotor Emf and Rotor Frequency - Torque Equation- Torque Slip Characteristics – Losses and efficiency.
Learning Outcomes: At the end of this unit, students should be able to

- Know about principle of operation of three phase induction motor (L2)

- Distinguish between squirrel cage and slip ring induction motors (L4)
- Know about various losses and computation of efficiency of induction motor (L4)
- Know about the torque developed by the induction motor (L4)
- Understand various characteristics of induction motor (L2)

UNIT – V(10Hrs)

Synchronous Machines: Principle and Constructional Features of Salient Pole and Round Rotor Machines – E.M.F Equation- Voltage Regulation by Synchronous Impedance Method- Theory of Operation of Synchronous Motor

Learning Outcomes: At the end of this unit, students should be able to

- Know about principle of working of alternator. (L2)
- Distinguish between salient pole and cylindrical rotor machines (L4)
- Know about emf equation. (L4)
- Know about predetermination of regulation of alternator by synchronous impedance method. (L4)
- Know about principle of operation of synchronous motor. (L4)

TEXTBOOKS:

1. “Electric Machines”, I. J. Nagrath & D. P. Kothari, Tata Mc Graw Hill, 7th Edition, 2005
2. “Basic Electrical Engineering”, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 3rd Edition, 2017.

REFERENCE BOOKS:

1. “Fundamentals of Electric Machines”, B. R. Gupta, Vandana Singhal, New age International Publishers, 3rd Edition, 2005.
2. “Electromechanics – III”, S. Kamakashiah, Overseas Publishers Pvt. Ltd.
3. “Principles of Electrical Engineering”, V.K. Mehta and Rohit Mehta, S. Chand Publications, 2005

Course Code	PULSE AND DIGITAL CIRCUITS LAB		L	T	P	C
21A040404			0	0	3	1.5
Pre-requisite	Electronic Devices & Circuits	Semester	III			

COURSE OBJECTIVES:

- To understand and design RC circuits as Integrator and differentiator.
- To verify various clipping and clamper circuits using PN junction diode.
- To Analyse and design of various multivibrator and sweep circuits.
- To understand fundamentals of basic logic gates and its applications.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Analyze RC circuits with different time constants.
CO2: Analyze different clipping and clamper circuits.
CO3: Analyze and design of various multivibrator and sweep circuits.
CO4: Design simple digital circuits using logic gates.

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. Linear wave shaping (RC Integrator & RC differentiator).
2. Non-Linear wave shaping – Clippers.
3. Non-Linear wave shaping – Clampers.
4. Bistable Multivibrator.
5. Astable Multivibrator.
6. Monostable Multivibrator.
7. Schmitt Trigger.
8. UJT Relaxation Oscillator.
9. Bootstrap sweep circuit.
10. Constant Current Sweep Generator using BJT.
11. Study of Logic Gates.
12. Realization of Binary to Gray code Converter.

LIST OF EXPERIMENTS BEYOND THE CURRICULUM:

1. Astable Multivibrators Using 555 IC.
2. Monostable Multivibrators Using 555 IC.
3. Logic Gates using DL.

Tools / Equipment Required:

1. Licensed simulation software/DC Power supplies, Multi meters, Function generator, CROs and all the required active devices.

NOTE: The students are required to design the circuit and they have to perform the analysis through simulator using Pspice/Equivalent Licensed simulation software tool. Further they are required to verify the result using necessary hardware in the hardware laboratory.

<table>
<tr><td>Course Code</td><td rowspan="2" colspan="2">BASIC SIMULATION LAB</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>21A040405</td><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Pre-requisite</td><td>Signals and Systems</td><td>Semester</td><td colspan="4">III</td></tr>
</table>

COURSE OBJECTIVES:

- To provide practical exposure with generation and simulation of basic signals using standardized tools.
- To teach analysing signals and sequences using Fourier, Laplace and Z-transforms.
- To enable to write programs for signal processing applications.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain the basic concepts of programming in MATLAB and use of built-in functions to perform assigned task.

CO2: Generate signals and sequences, input signals to the systems to perform various operations

CO3: Analyze signals using Fourier, Laplace and Z-transforms.

CO4: Verify Sampling theorem and Determine convolution and Correlation between signals and sequences.

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. Write a program to generate various Signals and Sequences: Periodic and Aperiodic, Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc function.
2. Perform operations on Signals and Sequences: Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
3. Write a program to find the trigonometric & exponential Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightages - Plot the discrete spectrum of the signal.
4. Write a program to find Fourier transform of a given signal. Plot its amplitude and phase spectrum.
5. Write a program to convolve two discrete time sequences. Plot all the sequences.
6. Write a program to find autocorrelation and cross correlation of given sequences.
7. Write a program to verify Linearity and Time Invariance properties of a given Continuous/Discrete System.

8. Write a program to generate discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.
9. Write a program to find magnitude and phase response of first order low pass and high pass filter. Plot the responses in logarithmic scale.
10. Write a program to find response of a low pass filter and high pass filter, when a speech signal is passed through these filters.
11. Write a program to generate Complex Gaussian noise and find its mean, variance, Probability Density Function (PDF) and Power Spectral Density (PSD).
12. Generate a Random data (with bipolar) for a given data rate (say 10kbps). Plot the same for a time period of 0.2 sec.
13. To plot pole-zero diagram in S-plane/Z-plane of given signal/sequence and verify its stability.

Note: All the experiments are to be simulated using MATLAB or equivalent software

Course Code	ELECTRICAL TECHNOLOGY LAB		L	T	P	C
21A020306			0	0	3	1.5
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To do experiments on DC generators and experiments on DC motors
- To do experiments on 1-ϕ transformer
- To do power measurements in 3-ϕ balanced and unbalanced circuits
- To do tests on 3-ϕ Induction motors
- To do experiment on Alternator and experiment on Synchronous motor

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand various characteristics of DC generators and DC motors.
CO2: Predetermine the efficiency and regulation of a 1-ϕ transformer.
CO3: Determine power measurement in 3-ϕ circuits.
CO4: Understand various characteristics of Induction motors and Synchronous Machines.

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. OCC of a separately excited DC generator
2. Load characteristics of DC shunt generator
3. Load characteristics of DC shunt motor
4. Swinburne's test
5. Speed control of DC shunt motor
6. OC & SC tests on a 1-ϕ transformer
7. Measurement of Active and reactive powers in a 3-ϕ balanced circuit
8. Measurement of 3-ϕ power using two wattmeter methods in unbalanced circuit
9. Load test on Squirrel cage Induction motor
10. Load test on Slip ring Induction motor
11. Predetermination of regulation of alternator by Synchronous impedance method
12. V and Inverted V curves of Synchronous motor

Note: Student must perform at least 10 experiments

Course Code	PYTHON PROGRAMMING		L	T	P	C
21A050701	(Common to CE, EEE, ME & ECE)		**1**	**0**	**2**	**2**
Pre-requisite	C Programming & Data Structures	Semester	III			

COURSE OBJECTIVES:

- To train the students in solving computational problems
- To elucidate solving mathematical problems using Python programming language
- To understand the fundamentals of Python programming concepts and its applications.
- To understand the object-oriented concepts using Python in problem solving.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Student should be able to understand the basic concepts of Python Programming language such as conditional processing, Loops, and other data structures.

CO2: Ability to explore python especially the built-in objects of Python.

CO3: Ability to create practical and contemporary applications such as Machine Learning algorithms.

CO-PO MAPPING:

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

Topics to be covered:

Introduction: What is a program, running python, Arithmetic operators, Value and Types.

Variables, Assignments and Statements: Assignment statements, Script mode, Order of operations, string operations, comments.

Functions: Function Definitions and Uses, Math functions,

Conditionals and Recursion: floor division and modulus, Boolean expressions, Logical operators, Conditional execution, Recursion, Keyboard input.

Dictionaries: A dictionary is a mapping, Dictionary as a collection of counters, it’s Looping

Tuples: Tuples are immutable, Tuple Assignment

Files: Persistence, Reading and writing, Format operator, Filename and paths,

Classes and Objects: Programmer-defined types, Classes, Objects, methods and modules.

The turtle module & tkinter module: graphics-based Object shapes drawing fundamentals, GUI design Fundamentals

LABORATORY EXPERIMENTS:

1. Install Python Interpreter and use it to perform different Mathematical Computations.
2. Write a Python Program to find sum of given n numbers
3. Write a Python Program to generate Fibonacci Numbers up to a given number
4. Write a Python Program to display multiplication Table of a given Number
5. Write a Python Program to read a list of names from keyboard, sort them and write them into a File
6. Write a Python Program to concatenate two files content and write the result into a new File.
7. Write a Python Program to perform the addition of two matrices.
8. Write a Python Program to search a given word in the given text file and display the number of occurrences of the string.
9. Write the step-by-step Solution procedure to find the LCM and GCD (HCF) of 2 given numbers
10. Find mean, median, mode for the given set of numbers in a list
11. Python Code to create module called "mathematics" having functions add (), subtract(), div(), mul() and access them by another Program.
12. Develop Python program for illustrating the object-oriented features supported by Python
13. Write a function that draws a Pyramid with #symbols

```
      #
     # ##
    # # # ##
   # # # # # ##
```

up to 15 hashes at the bottom

14. Consider turtle object. Write functions to draw triangle, rectangle, polygon, circle and sphere. Use object-oriented approach.
15. Using turtles concept draw Olympic Symbol
16. The time module provides a function, also named time that returns the current Greenwich Mean Time in "the epoch", which is an arbitrary time used as a reference point

    a. >>> import time
    b. >>>time.time () 14377460
        a. 94.5735958

17. Write a script that reads the current time and converts it to a time of day in hours, minutes, and seconds, plus the number of days since the epoch.
18. Given a text of characters, write a program which counts number of vowels, consonants and special characters.
19. Write program which performs the following operations on list's. Don't use built-in functions
    a) Updating elements of a list
    b) Concatenation of list's
    c) Check for member in the list
    d) Insert into the list
    e) Sum the elements of the list
    f) Push and pop element of list
    g) Sorting of list
    h) Finding biggest and smallest elements in the list
    i) Finding common elements in the list
20. Design a Python script using the Turtle graphics library to construct a turtle bar chart representing the grades obtained by N students read from a file categorizing them into distinction, first class, second class, third class and failed.
21. Develop Python Program to create Login Screen and evaluate user Input?

TEXTBOOKS:

1. "Think Python", Allen B. Downey, SPD/O'Reilly, 2nd edition, 2016.

REFERENCE BOOKS:

1. "The Complete Reference: Python", Martin C. Brown, McGraw-Hill, 2018.
2. "Fundamentals of Python", Kenneth A. Lambert, B.L. Juneja, CENGAGE, 2015.
3. "Core Python Programming", R. Nageswara Rao, Dreamtech Press, 2nd edition, 2019

Course Code	CONSTITUTION OF INDIA		L	T	P	C
21A000002	(Common to all branches)		2	0	0	0
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and Election Commission of India.
- To understand the central-state relation in financial and administrative control

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand historical background of the constitution making and its importance for building a democratic India. **(K2)**

CO2: Understand the functioning of three wings of the government i.e., executive, legislative and judiciary. **(K2)**

CO3: Understand the value of the fundamental rights and duties for becoming good citizen of India. **(K2)**

CO4: Analyze the decentralization of power between central, state and local self-government **(K4)**

CO5: Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy. **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction to Indian Constitution – Constitution -Meaning of the term - Indian Constitution- Sources and constitutional history - Features– Citizenship – Preamble - Fundamental Rights and Duties - Directive Principles of State Policy.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of Indian constitution (L1)
- Apply the knowledge on directive principle of state policy (L3)
- Analyze the History and features of Indian constitution (L4)
- Learn about Preamble, Fundamental Rights and Duties (L1)

UNIT – II (9 Hrs)

Union Government and its Administration Structure of the Indian Union - Federalism - Centre-State relationship – President's Role, power and position - PM and Council of ministers - Cabinet and Central Secretariat –Lok Sabha - Rajya Sabha - The Supreme Court and High Court - Powers and Functions

Learning Outcomes: At the end of this unit, students should be able to

- Understand the structure of Indian government (L1)
- Differentiate between the state and central government (L4)
- Explain the role of President and Prime Minister (L2)
- Know the Structure of supreme court and High court (L1)

UNIT – III (9 Hrs)

State Government and its Administration - Governor - Role and Position -CM and Council of ministers - State Secretariat-Organization Structure and Functions

Learning Outcomes: At the end of this unit, students should be able to

- Understand the structure of state government (L1)
- Analyze the role of Governor and Chief Minister (L4)
- Explain the role of State Secretariat (L2)
- Differentiate between structure and functions of state secretariat (L4)

UNIT – IV (9 Hrs)

Local Administration - District's Administration Head - Role and Importance - Municipalities - Mayor and role of Elected Representatives -CEO of Municipal Corporation Panchayati Raj - Functions– PRI –Zilla Parishath - Elected officials and their roles – CEO, Zilla Parishath - Block level Organizational Hierarchy - (Different departments) - Village level - Role of Elected and Appointed officials - Importance of grass root democracy

Learning Outcomes: At the end of this unit, students should be able to

- Understand the local Administration (L1)
- Compare and contrast district administration's role and importance (L4)
- Analyze the role of Mayor and elected representatives of Municipalities (L4)
- Learn about the role of Zilla Parishath block level organization (L1)

UNIT – V (9 Hrs)

Election Commission - Election Commission- Role of Chief Election Commissioner and Election Commissionerate - State Election Commission -Functions of Commissions for the welfare of SC/ST/OBC and Women

Learning Outcomes: At the end of this unit, students should be able to

- Know the role of Election Commission (L1)

- Contrast and compare the role of Chief Election commissioner and Commissionerate (L4)
- Analyze the role of state election commission (L4)
- Evaluate various commissions viz SC/ST/OBC and women (L6)

TEXTBOOKS:

1. "Introduction to the Constitution of India", Durga Das Basu, Prentice Hall of India Pvt. Ltd. New Delhi
2. "Indian Constitution", Subash Kashyap, National Book Trust

REFERENCE BOOKS:

1. "Dynamics of Indian Government & Politics", J.A. Siwach,
2. "Constitutional Law of India", H.M.Sreevai, 4th edition in 3 volumes (Universal Law Publication)
3. "Indian Government and Politics", J.C. Johari, Hans India

Course Code	CONTROL SYSTEMS		L	T	P	C
21A040303			3	0	0	3
Pre-requisite	Mathematical Methods	Semester	IV			

COURSE OBJECTIVES:

- Merits and demerits of open loop and closed loop systems; the effect of feedback
- The use of block diagram algebra and Mason's gain formula to find the overall transfer function
- Transient and steady state response, time domain specifications and the concept of Root loci
- Frequency domain specifications, Bode diagrams and Nyquist plots
- State space modelling of Control system

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand the basic principles of systems and their mathematical Representations.

CO2: Analyse time response analysis, error constants, and stability characteristics of a given mathematical model using different methods.

CO3: State space formulation for obtaining mathematical and Root locus.

CO4: Understand the Bode, Nyquist, and Polar plots for stability calculations, Design and develop different compensators, controllers.

CO5: Analyze the stability concepts, state space models, controllability and observability for demonstrate the use of these techniques.

CO-PO MAPPING:

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

UNIT – I (12 Hrs)

Control Systems Concepts: Open loop and closed loop control systems and their differences- Examples of control systems Classification of control systems, Feedback characteristics, Effects of positive and negative feedback, Mathematical models – Differential equations of translational and rotational mechanical systems and electrical systems, Analogous Systems, Block diagram reduction methods – Signal flow graphs - Reduction using Mason's gain formula.

Learning Outcomes: At the end of this unit, students should be able to

- Write the differential equations for mechanical and electrical systems. (L3)
- Obtain the transfer function from block diagrams, servo motors and signal flow graphs

UNIT – II (12 Hrs)

Time Response Analysis: Step Response - Impulse Response - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants, P, PI, PID Controllers.

Learning Outcomes: At the end of this unit, students should be able to

- Analyse the time domain specifications (L4)
- Calculate the steady state errors (L3)
- Understand about Proportional, Integral and Derivative controllers along with combinations (L2)

UNIT – III (13 Hrs)

Stability Analysis in Time Domain: The concept of stability – Routh's stability criterion – Stability and conditional stability – limitations of Routh's stability. The Root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci.

Learning Outcomes: At the end of this unit, students should be able to

- Analyse the concept of stability in time domain (L4)
- Apply the concept of Routh's stability and Root locus in time domain (L3)

UNIT – IV (11 Hrs)

Frequency Response Analysis: Introduction, Frequency domain specifications-Bode Diagrams-Determination of Frequency domain specifications. Polar Plots-Nyquist Plots- Phase margin and Gain margin.

Learning Outcomes: At the end of this unit, students should be able to

- Evaluate the frequency domain specifications from Bode, Polar and Nyquist plots (L4)
- Design Compensators for various systems (L5)
- Deducing transfer functions from Bode Plots (L4)
- Understand difference between Phase and Gain margins (L2)

UNIT – V (12 Hrs)

State Space Analysis of Continuous Systems: Concepts of state, state variables and state model, state models - differential equations & Transfer function models - Block diagrams. Diagonalization, Transfer function from state model, Solving the Time invariant state Equations-State Transition Matrix and its Properties. System response through State Space models. The concepts of controllability and observability.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of state space, controllability, and observability (L2)
- Obtain the transfer function from sate space and vice versa (L3)
- Understand the state transition method of solving time invariant state equations (L2)

TEXTBOOKS:

1. "Modern Control Engineering", Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., 5th edition, 2010.
2. "Control Systems Engineering", I. J. Nagrath and M. Gopal, New Age International (P) Limited Publishers, 5th edition, 2007.

REFERENCE BOOKS:

1. "Control Systems Principles & Design", M. Gopal, Mc Graw Hill Education, 4th Edition, 2012.
2. "Automatic Control Systems", B. C. Kuo and Farid Golnaraghi, John wiley and sons, 8th edition, 2003.
3. "Schaum's outlines Feedback and Control Systems", Joseph J Distefano III, Allen R Stubberud & Ivan J Williams, Mc Graw Hill Education, 2nd Edition, 2013.
4. "Control System Design", Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado, Pearson, 2000.
5. "Feedback Control of Dynamic Systems", Gene F. Franklin J.D. Powell and Abbas Emami-Naeini, Pearson, 6th Edition, 2010.

Course Code	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS (Common to all branches)		L	T	P	C
21A110203			3	0	0	3
Pre-requisite	NIL	Semester	IV			

COURSE OBJECTIVES:

- To inculcate the basic knowledge of microeconomics and financial accounting.
- To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost.
- To know the various types of Market Structures & pricing methods and its strategies.
- To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
- To provide fundamental skills on accounting and to explain the process of preparing financial statements.

COURSE OUTCOMES:

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

CO1: Analyse the consumer behaviour with regard to their product or services and measure demand of a particular product or services by applying various methods in given situation

CO2: Determine Break Even Point (BEP) of an enterprise Assess the cost behaviour, costs useful for managerial decision making

CO3: Determine the price of a product or services in given market condition

CO4: Analyze the financial position by using different types of ratios and interpret the financial accounting

CO5: Evaluate the investment proposals under payback period, ARR, IRR, NPV & PI methods

CO-PO MAPPING:

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

UNIT- I (11 Hrs)

Introduction to Managerial Economics and Demand Analysis: Managerial Economics– Definition – Nature & Scope - Contemporary importance of Managerial Economics - Demand Analysis - Concept of Demand - Demand Function - Law of Demand - Elasticity of Demand - Significance - Types of Elasticity - Measurement of Elasticity of Demand- Demand Forecasting- Factors governing Demand Forecasting - Methods of Demand Forecasting - Relationship of Managerial Economics with Financial Accounting and Management.

Learning Outcomes: At the end of this unit, students should be able to

- Know the nature and scope of Managerial Economics and its importance. (L1)
- Understand the concept of demand and its determinants. (L2)
- Analyse the elasticity and degree of elasticity. (L4)
- Evaluate demand forecasting methods. (L5)
- Design the process of demand estimation for different types of demand. (L6)

UNIT- II (10 Hrs)

Theory of Production and Cost Analysis:

Production Function – Short-run and Long-run Production Function -Isoquants and Iso costs, MRTS –Least cost combination of Inputs, Cobb-Douglas Production Function - Laws of Returns – Internal and External Economies of scale – **Cost & Break-Even Analysis** - Cost concepts and Cost behavior - Break-Even Analysis (BEA)–Determination of Break-Even Point (Simple Problems)-Managerial significance of Break-Even Analysis

Learning Outcomes: At the end of this unit, students should be able to

- Know the production function, Input-output relationship and different cost concepts. (L1)
- Apply the least-cost combination of inputs. (L3)
- Analyse the behaviour of various cost concepts. (L4)
- Evaluate BEA for real time business decisions. (L5)
- Develop Profit appropriation for different levels of business activity. (L6)

UNIT- III (11 Hrs)

Introduction to Markets and New Economic Environment:

Market structures Types of Markets-Perfect and Imperfect Competition- Features of Perfect Competition– Monopoly -Monopolistic Competition –Oligopoly-Price-Output Determination-Pricing Methods and Strategies- Forms of Business Organizations - Sole Proprietorship - Partnership – Joint Stock Companies-Public Sector Enterprises - New economic Environment - **Economic Liberalization – Privatization – Globalization.**

***Learning Outcomes*:** At the end of this unit, students should be able to

- Know the production function, input-output relationship and different cost concepts. (L1)
- Apply the least-cost combination of inputs. (L3)
- Analyse the behaviour of various cost concepts. (L4)
- Evaluate BEA for real time business decisions. (L5)

UNIT- IV (10 Hrs)

Capital and Capital Budgeting: Concept of Capital-Significance-Types of Capital-Components of Working Capital - Sources of Short-term and Long-term Capital -Estimating Working capital requirements-**Capital Budgeting**–Features of Capital Budgeting Proposals – Methods and

Evaluation of Capital Budgeting Projects – Pay Back Method – Accounting Rate of Return (ARR) – Net Present Value (NPV) – Internal Rate Return (IRR) Method (simple problems)

Learning Outcomes: At the end of this unit, students should be able to

- Know the concept of Capital Budgeting and its importance in business (L1)
- Contrast and compare different investment appraisal methods. (L4)
- Analyse the process of selection of investment alternative using different appraisal methods. (L4)
- Evaluate methods of Capital budgeting techniques. (L5)
- Design different investment appraisals and make wise investments. (L6)

UNIT–V (10 Hours)

Introduction to Financial Accounting and Analysis: Financial Accounting – Concept – Emerging need and Importance - Double-Entry Book Keeping, Journal, Ledger, Trial Balance - Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet (with simple adjustments). ***Financial Analysis*** - Ratios- Liquidity, Leverage, Profitability and Activity Ratios (Simple Problems)

Learning Outcomes: At the end of this unit, students should be able to

- Know the concept and convention and significance of accounting. (L1)
- Apply the fundamental knowledge of accounting while posting the Journal entries. (L3)
- Analyze the process and preparation of Financial Accounts and Financial Ratios. (L4)
- Evaluate the Financial performance of an enterprise by using financial statements. (L5)

TEXTBOOKS:

1. "Managerial Economics", Varshney & Maheswari, S. Chand, 2013.
2. "Managerial Economics and Financial Analysis", Aryasri, MGH, 4th edition, 2019

REFERENCE BOOKS:

1. "Managerial economics", Ahuja HL, S. Chand, 3rd edition, 2013.
2. "Managerial Economics and Financial Analysis", S. A. Siddiqui and A. S. Siddiqui, New Age International, 2013.
3. "Principles of Business Economics", Joseph G. Nellis and David Parker, Pearson, 2nd edition, New Delhi.
4. "Managerial Economics in a Global Economy", Dominick Salvatore, Cengage Learning, 2013.

Course Code	DIGITAL SYSTEM DESIGN		L	T	P	C
21A040406			3	0	0	3
Pre-requisite	Pulse and Digital Circuits	Semester	IV			

COURSE OBJECTIVES:

- To be able to use computer-aided design tools for development of complex digital logic circuits.
- To illustrate the concepts and study the procedures for the analysis and design of combinational circuits and sequential circuits.
- To introduce the concepts of programmable logic devices.
- To be able to model and simulate with hardware description languages.

COURSE OUTCOMES:

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

CO1: Explain the concepts of VHDL language.
CO2: Design and implement various combinational circuits using VHDL.
CO3: Design and implement various sequential circuits using VHDL.
CO4: Explain error detection and correction techniques.
CO5: Design Digital systems.

CO-PO MAPPING:

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

UNIT – I (12 Hrs)

Hardware Description Languages: HDL Based Digital Design, The VHDL Hardware Description Language–Program Structure, Types, Constants and Arrays, Functions and procedures, Libraries and Packages, Structural design elements, Dataflow design elements, Behavioral design elements, The Time Dimension, Simulation, Test Benches, VHDL Features for Sequential Logic Design, Synthesis.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various data types used in VHDL language. (L2)
- Understand the VHDL operators and apply them in digital design. (L2)
- Explain various VHDL models to implement digital circuits. (L2)

UNIT – II (14 Hrs)

Combinational Circuits: Combinational circuits, Analysis & Design procedure, Binary Adder-subtractor, Decimal Adder, Binary Multiplier, Magnitude comparator, Decoder, Encoders, Multiplexers (74 –series MSI) and Designing Using combinational PLDs like PLAs, PALs, PROMs CMOS PLDs and their VHDL models.

Learning Outcomes: At the end of this unit, students should be able to

- Apply Boolean algebra for describing combinational digital circuits. (L3)
- Analyse standard combinational circuits such as adders, subtractors, multipliers, comparators etc. (L4)
- Design of digital circuits using PLD structures. (L5)
- Use VHDL in design of combinational logic circuits to analyse the behaviour. (L4)

UNIT – III (12 Hrs)

Sequential Circuits: Sequential Circuits, Latches Flips-Flops, Analysis of Clocked sequential circuits, State Reduction & Assignment, Design procedure, Registers & Counters – Registers, Shift Registers, Ripple Counters, Synchronous counters, other counters (Ring counters; Johnson counters, LFSR counter) (74 –series MSI) and their VHDL models.

Learning Outcomes: At the end of this unit, students should be able to

- Describe behaviour of Flip-Flops and Latches. (L2)
- Compare Moore and Mealy machine models. (L4)
- Utilize concepts of state and state transition for analysis and design of sequential circuits (L3)
- Implementation of different sequential circuits using VHDL. (L3)

UNIT – IV (13 Hrs)

Asynchronous Sequential Logic: Introduction, Analysis Procedure, Circuits with Latches, Design Procedure, Reduction of State flow tables, Race-free State Assignment, Hazards. Types of memories, Memory Decoding, Error detection and correction.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts State Flow tables, Race-free State Assignment and Hazards. (L2)
- Describe functional differences between different types of RAM & ROM. (L2)
- Explain error detection and correction techniques. (L2)

UNIT – V (11 Hrs)

Design Examples (Using VHDL): Barrel shifter, Comparators, Floating-point encoder, and Dual parity encoder.

Learning Outcomes: At the end of this unit, students should be able to

- Design different digital systems. (L5)

- Develop VHDL models for various digital Systems. (L5)

TEXTBOOKS:

1. "Digital Design Principles and Practices", John F. Wakerly, Pearson Education., 4th edition, 2009
2. "Fundamentals of Logic Design", Charles H.Roth Jr., CENGAGE Learning, 5th edition , 2012.
3. "Digital Design", M. Morris Mano & Michel D. Ciletti, Pearson, 5th Edition.

REFERENCE BOOKS:

1. "Digital Logic Design", M. Morris Mano and Michael D. Cilleti., Pearson Education., 4th edition, 2013
2. "Fundamentals of digital logic with VHDL design", Stephen Brown and Zvonko Vranesic, McGraw Hill Higher Education, 2nd edition.
3. "A VHDL PRIMER", J. Bhasker, PHI Learning, 3rd edition, Eastern Economy Edition, 2010.
4. "Switching theory and Finite Automata Theory", Zvi Kohavi and Nirah K. Jha, Cambridge, 3rd Edition.

<table>
<tr><td>Course Code</td><td rowspan="2">ELECTRONIC CIRCUITS ANALYSIS AND DESIGN</td><td colspan="2">L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>21A040407</td><td colspan="2">3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td>Electronic Devices and Circuits</td><td>Semester</td><td colspan="4">IV</td></tr>
</table>

COURSE OBJECTIVES:

- To design and analyze single and multi-stage amplifiers using BJT & FET at low and high frequencies.
- To explain effect of negative feedback on amplifier characteristics.
- To teach basic principles for analysing RC & LC oscillator circuits.
- To introduce different types of large signal amplifiers and tuned amplifiers.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Analyse low frequency BJT & FET amplifiers using hybrid pie model.

CO2: Analyse the frequency response of single stage amplifiers at high and low frequencies.

CO3: Analyze and examine few common two stage transistor amplifier circuits viz., Cascade amplifiers, Cascode amplifiers, Darlington pairs.

CO4: Analyse and examine the characteristics of various types of feedback configurations and Oscillators.

CO5: Analyse different types of power amplifier and Tuned amplifiers.

CO-PO MAPPING:

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

UNIT – I (12 Hrs)

BJT Small Signal Models: Bipolar linear amplifier, Graphical and ac equivalent circuit, Small signal hybrid-∏ equivalent circuit, Hybrid-∏ equivalent circuit including the early effect, other small signal parameters and equivalent circuits-h-parameters.

Small Signal Analysis: Basic CE amplifier circuit, Circuit with Emitter resistance, ac load line analysis, maximum symmetrical swing, Small signal analysis-input and output impedances, Voltage gain, Current gain of CB, CC amplifiers, Problem solving.

Small Signal Amplifiers Using JFET/MOSFETS: Graphical analysis, Load line and small signal parameters, Small signal equivalent circuit, Small signal analysis of Common source, Common drain, Common gate amplifiers, Comparison of the three basic amplifier configurations, Problem solving.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts and equivalent circuit models of small signal amplifiers. (L2)
- Analyse low frequency models of BJT and FET. (L4)
- Design BJT and FET amplifier circuits. (L5)
- Determine performance parameters of BJT and FET amplifiers. (L2)

<u>UNIT – II</u> (12 Hrs)

Frequency Response: Amplifier frequency response-different ranges, short circuit and open circuit time constants, time response, transistor amplifiers with circuit capacitors-coupling capacitor effects, load capacitor effects, Bypass capacitor effects, Problem solving, combined effects of coupling and bypass capacitor, high-frequency response model for BJT and MOSFETs, short circuit current gain, Miller effect and its applications, unity-gain bandwidth in BJT and FET amplifiers.

Learning Outcomes: At the end of this unit, students should be able to

- Analyse the frequency response of single stage amplifiers using BJT & FET at high and low frequencies. (L4)
- Design of single stage amplifiers using BJT and FET with and without coupling capacitors. (L5)
- Explore the various effects of load, bypass and coupling capacitor on the performance of amplifier circuits. (L3)

<u>UNIT- III</u> (12 Hrs)

Multistage Amplifiers: Classification of amplifiers, Methods of coupling, Analysis of two stage RC coupled amplifier, Darlington pair amplifier, Cascode amplifier, Boot-strap emitter follower, Analysis of multi stage amplifiers using FET, Differential amplifier using BJT.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the classification of Amplifiers. (L2)
- Understand different coupling methods and their importance. (L2)
- Analyse different multistage configurations. (L4)

<u>UNIT – IV</u> (12 Hrs)

Feedback Amplifiers: General Considerations, Properties of Negative Feedback, Types of Amplifiers, Sense and Return Techniques, Polarity of Feedback, Feedback Topologies, Effect of Nonideal I/O Impedances, Stability in Feedback Systems, Analysis of a feedback Amplifiers - Voltage – Series, Current Series, Current-shunt and Voltage-shunt, Illustrative problems.

Oscillators: General Considerations, LC Oscillators, Phase Shift Oscillator, Wien-Bridge Oscillator, Crystal Oscillators, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand concept of different feedback topologies. (L2)

- Determine the effect of feedback on amplifier characteristics. (L2)
- Analyse characteristics of various types of feedback configurations (L4)
- Explore working principle of oscillator. Also examine different types of oscillators, RC & LC, with detailed mathematical analysis and illustrations. (L3)

UNIT – V (13 Hrs)

Power Amplifiers: Classes of amplifiers-Operations of Class A, B, AB, C, class-A: Inductively coupled amplifier, transformer-coupled common emitter amplifier, transformer-coupled emitter-follower amplifier, Class-AB Push-pull complementary output stages-class-AB output stage with diode biasing, class-AB biasing using the VBE multiplier, class-AB output stage with input buffer transistors, class –AB output stage utilizing the Darlington configuration, Illustrative Problems.

Tuned Amplifiers: Introduction to tuned amplifiers, Role of Q-Factor, Single-tuned, Double tuned and Stagger-tuned amplifiers.

Learning Outcomes: At the end of this unit, students should be able to

- Know most common classes of power amplifier and their basic characteristics. (L2)
- Analyse complementary symmetry topologies. (L4)
- Evaluate conversion efficiency of various topologies. (L4)
- Understand the working of different types of Tuned amplifiers (L2)

TEXTBOOKS:

1. "Electronic Circuits – Analysis and Design", Donald A Neamen, McGraw Hill (India), 3rd Edition, 2019.
2. "Integrated Electronics", J. Millman, C Chalkias, McGraw Hill Education (India) Private Ltd., 4th Edition, 2015.

REFERENCE BOOKS:

1. "Fundamentals of Micro Electronics", Behzad Razavi, Wiley, 2010.
2. "Pulse, Digital and Switching Waveforms", Millman and Taub, Tata McGraw-Hill Education, 3rd Edition, 2011
3. "Electronic Devices and Circuits Theory", Robert L. Boylestad and Louis Nashelsky, Pearson/Prentice Hall, 9th Edition, 2006.
4. "Electronic Circuit Analysis", K. Lal Kishore, B S Publications, 2nd Edition, 2008.

Course Code	ANALOG COMMUNICATIONS		L	T	P	C
21A040408			3	0	0	3
Pre-requisite	Signals and Systems, Electronic Devices and Circuits	Semester	IV			

COURSE OBJECTIVES:

- To introduce various modulation and demodulation techniques of analog communication system.
- To analyze different parameters of analog communication techniques.
- Know Noise Figure in AM & FM receiver systems.
- Understand Function of various stages of AM, FM transmitters and know characteristics of AM & FM receivers.
- Understand the concepts of information theory.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Analyze the Frequency spectra of Modulated signals used in various Amplitude modulation schemes.
CO2: Analyze the Frequency spectra of Modulated signals used in various Angle modulation schemes.
CO3: Compare the performance of communication systems by evaluating Figure of Merit for different modulation schemes.
CO4: Compare the performance of different Analog Pulse modulation schemes.
CO5: Analyze the Channel performance using information theory.

CO-PO MAPPING:

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

UNIT – I (13 Hrs)

Introduction: Elements of communication systems, Information, Messages and Signals, Modulation, Modulation Methods, Modulation Benefits and Applications.

Amplitude Modulation & Demodulation: Baseband and carrier communication, Amplitude Modulation (AM), Rectifier detector ,Envelope detector, Double sideband suppressed carrier (DSB-SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Frequency mixer, sideband and carrier power of AM, Generation of AM signals, Single sideband (SSB) transmission, Time domain representation of SSB signals & their demodulation schemes (with carrier and suppressed carrier), Generation of SSB signals, Vestigial sideband (VSB) modulator & demodulator, Frequency division multiplexing (FDM), Illustrative

Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts of Amplitude Modulation and demodulation techniques. (L2)
- Apply the concepts to solve problems in Amplitude modulation Schemes. (L3)
- Analyse frequency spectra of modulated signals used in various amplitude modulation (L4)
- Compare the Performance of different amplitude modulation techniques. (L4)

<u>UNIT – II</u> (12 Hrs)

Angle Modulation & Demodulation: Concept of instantaneous frequency, Generalized concept of angle modulation, Bandwidth of angle modulated waves–Narrow band frequency modulation (NBFM) and Wide band FM (WBFM), Phase modulation, Verification of Frequency modulation bandwidth relationship, Features of angle modulation, Generation of FM waves-Indirect method, Direct generation; Demodulation of FM, Band pass limiter, Practical frequency demodulators, Small error analysis, Pre-emphasis & De-emphasis filters, FM Capture Effect, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts of Angle modulation and demodulation techniques. (L2)
- Understand importance Pre-emphasis & de-emphasis circuit in FM modulation. (L2)
- Apply the concepts to solve problems in Angle modulation Schemes. (L3)
- Analyse frequency spectra of modulated signals used in various angle modulation(L4)

<u>UNIT – III</u> (11 Hrs)

Noise in Communication Systems: Thermal noise, Time domain representation of narrow band noise, filtered white noise, Quadrature representation of narrow band noise, Envelope of narrow band noise plus sine wave, Signal to noise ratio & probability of error, Noise equivalent bandwidth, Effective noise temperature, and Noise figure, Baseband systems with channel noise, Performance analysis (i.e. finding SNR expression) of AM, DSB-SC, SSB-SC, FM, PM in the presence of noise, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand different types of noise and sources that effect the performance of the communication system. (L2)
- Analyse performance of analog communication system in the presence of noise. (L4)
- Compare the performance of communication system by evaluating figure of merit for different schemes of modulation. (L4)

<u>UNIT – IV</u> (10 Hrs)

Analog Pulse Modulation Schemes: Pulse amplitude modulation – Natural sampling, flat-top sampling and Pulse amplitude modulation (PAM) & demodulation, Pulse-Time Modulation – Pulse Duration and Pulse Position modulations, and demodulation schemes, PPM spectral analysis, Illustrative Problems.

Radio Receiver: Working principle of Super heterodyne AM and FM Receivers along with suitable block diagrams, Sensitivity, Selectivity and fidelity.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts of Analog Pulse Modulation and Demodulation techniques. (L2)
- Understand the concepts of AM and FM receivers. (L2)
- Apply the concepts to solve problems in Analog pulse modulation schemes. (L3)
- Analyse the performance of AM and FM receivers. (L4)
- Compare the Performance of different Analog Pulse Modulation techniques. (L4)

<u>UNIT – V</u> (13 Hrs)

Information Theory: Introduction, Information and Entropy, and its properties, source coding Theorem, Data Compaction – Prefix coding, Huffman coding, Discrete Memoryless channels, Mutual Information, and its properties, Channel capacity, Channel coding Theorem, Application to binary symmetric channels, differential entropy and mutual information, Information capacity theorem, implication of information capacity theorem, Rate Distortion, Illustrative problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts of information theory and different coding techniques. (L2)
- Analyse Binary symmetric channel. (L4)
- Design the channel performance using information theory. (L5)
- Derive equation for Entropy, Mutual information and channel capacity for all types of channels. (L3)

<u>TEXTBOOKS:</u>

1. "Modern Digital and Analog Communication Systems", B. P. Lathi, Oxford Univ. Press, 3rd Edition, 2006.
2. "Communication Systems", John Wiley & Sons, Simon Haykin, 3rd Edition, 2010.
3. "Digital and Analog Communication Systems", Sham Shanmugam, Wiley-India edition, 2006.

<u>REFERENCE BOOKS:</u>

1. "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", Bruce Carlson, & Paul B. Crilly, McGraw-Hill International Edition, 5th Edition, 2010.
2. "Principles of Communication Systems", Herbert Taub & Donald L Schilling, Tata McGraw-Hill, 3rd Edition, 2009.
3. "Principles of Communication – Systems Modulation & Noise", R. E. Ziemer & W. H. Tranter, Jaico Publishing House, 5th edition, 2001.
4. "Electronics & Communication System", George Kennedy and Bernard Davis, TMH, 2004.

Course Code	DIGITAL SYSTEM DESIGN LAB		L	T	P	C
21A040409			**0**	**0**	**3**	**1.5**
Pre-requisite	Pulse and Digital Circuits	Semester	IV			

COURSE OBJECTIVE:

- To understand and develop HDL source code for logic gates.
- To develop HDL source code for combinational and sequential circuits.
- To simulate combinational and sequential circuits.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Design and simulate combinational circuits using VHDL.

CO2: Design and simulate sequential circuits using VHDL.

CO3: Analysis of simulation results and schematic diagram of combinational and sequential logic circuits.

CO4: Design simple Digital System (ALU) and implement using VHDL.

CO-PO MAPPING:

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

Students are required to do the following.

- Target Device Specifications
- Simulation
- Generate RTL Schematic.
- Generate Technology Map.
- Generate Synthesis report.
- Design Summary.

LIST OF EXPERIMENTS:

1. Realization of Logic Gates.
2. Adders and Subtractors.
3. BCD Adder.
4. 3- to - 8Decoder- 74138.
5. 8 x 1 Multiplexer-74151 and 2 x 4 De-multiplexer-74155.
6. 4-Bit Comparator-7485.

7. Flip-Flop-7474.
8. Decade counter-7490.
9. Shift registers-7495.
10. ALU Design.
11. Ones counter.
12. Sequence Detector.

ADDITIONAL EXPERIMENTS:

1. Ripple Counters Realization (Mod –X).
2. Binary to Gray code converter.
3. Design of 4 Bit LFSR.

Note: Use VHDL/ Verilog HDL

EDA Tools/Hardware Required:

1. EDA Tool that supports FPGA Programming including Xilinx / Altera (Intel) / Cypress / Equivalent Industry Standard tool along with corresponding FPGA Hardware.
2. Desktop Computer with appropriate Operating system that supports the EDA tools.

Course Code	ELECTRONIC CIRCUIT ANALYSIS AND DESIGN LAB		L	T	P	C
21A040410			0	0	3	1.5
Pre-requisite	Electronic Devices and Circuits	Semester	IV			

COURSE OBJECTIVES

- Help students make transition from analysis of electronic circuits to design of electronic circuits.
- To understand the Analysis of transistor amplifier at different frequencies.
- To understand the design of transistor oscillators at desired frequencies.
- To understand the Analysis of transistor power amplifier.
- To understand the concept of designing of tuned amplifier.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Analyze the single and multistage amplifiers at low, mid and high frequencies using simulation software and Hardware.

CO2: Analyze the transistor oscillators using simulation software and Hardware.

CO3: Determine the efficiencies of power amplifiers using simulation software.

CO4: Analyze Frequency response of tuned amplifiers using hardware and Multisim software.

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. CE Amplifier.
2. Two Stage RC Coupled Amplifier
3. Darlington Pair Amplifier
4. Voltage-Series Feedback Amplifier
5. Current-Shunt Feedback Amplifier
6. RC Phase Shift Oscillator
7. Hartley Oscillator
8. Bootstrapped Emitter Follower
9. Class A Series-fed Power Amplifier
10. Class B Push-Pull Power Amplifier
11. Complementary Symmetry Class B Push-Pull Power Amplifier
12. Single Tuned Voltage Amplifier.

Note: Minimum of Ten Experiments must be performed

ADDITIONAL EXPERIMENTS:

1. Colpitt's Oscillator
2. Wien Bridge Oscillator

Note: The students are required to design the electronic circuit and they have to perform the analysis through simulator using Multisim/Pspice/Equivalent Licensed simulation software tool. Further they are required to verify the result using necessary hardware in the hardware laboratory.

<table>
<tr><td>Course Code</td><td rowspan="2">ANALOG COMMUNICATIONS LAB</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>21A040411</td><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>Pre-requisite</td><td>Signals and Systems, Electronic Devices and Circuits</td><td>Semester</td><td colspan="3">IV</td></tr>
</table>

COURSE OBJECTIVES:

- To familiarize the students with basic analog communication systems. Integrate theory with experiments so that the students appreciate the knowledge gained from the theory course.
- Understand all types of analog modulation/demodulation principles.
- Substantiate pulse modulation techniques.
- To design and implement different modulation and demodulation techniques.
- To write and execute programs in MATLAB to implement various modulation techniques.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Analyze different analog modulation techniques.
CO2: Design and implement different modulation and demodulation techniques.
CO3: Observe the performance of system by plotting graphs & Measure radio receiver characteristics.
CO4: Simulate all digital modulation and demodulation techniques.

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. (a) Develop an Amplitude modulation circuit to get modulated signal for various modulation indices. Verify the Spectrum of the modulated signal experimentally and find its Bandwidth.
   (b) Design a suitable demodulator circuit to recover original information signal.
2. Generate a DSB - SC signal using suitable circuit diagram. Extract information bearing signal from DSB-SC signal. Calculate the power of the DSB-SC signal.
3. (a) Develop a Frequency modulation circuit to get modulated signal for various modulation depths. Verify the Spectrum of the modulated signal experimentally and find its Bandwidth.
   (b) Design a suitable demodulator circuit to recover original information signal.
4. (a) Design a Mixer circuit to verify the principle of operation of Mixer experimentally.

(b) Design a Pre-emphasis & de-emphasis circuit and verify its importance experimentally and plot necessary graph.

5. Construct Pulse Amplitude Modulation circuit and plot modulated signal. Extract the modulated signal by constructing suitable demodulator circuit.
6. Construct Pulse Width Modulation circuit and plot modulated signal. Extract the modulated signal by constructing suitable demodulator circuit.
7. Construct Pulse Position modulation circuit and plot modulated signal. Extract the modulated signal by constructing suitable demodulator circuit.
8. Radio receiver measurements–Sensitivity Selectivity and Fidelity.
9. Simulate AM and FM signals and find power spectrum of each signal. Plot the graphs.
10. Simulate PAM and PWM signals and find power spectrum of each signal. Plot the graphs.
11. Generate a complex Gaussian noise (with zero mean unit variance). And pass through an LTI system. Find the power spectrum density of the noise signal available at the output of LTI system.
12. Make use of AM signal from experiment no. 9 add Gaussian noise (with zero mean and unity variance) to the signal. Extract the information bearing signal using suitable system.
13. Simulate Huffman coding.

EQUIPMENT & SOFTWARE REQUIRED:

Software:

1. Simulations software (MATLAB)

Equipment:

1. Regulated Power Supply (0-30) V
2. CROs (0-20) MHz
3. Function Generators (0-3) MHz
4. RF Signal Generators (0-1000) MHz
5. Multimeters
6. Required Electronic components (active and passive) for the design of experiments.
7. Radio Receiver Demo kits or Trainers.
8. RF power meter frequency range 0–1000MHz
9. Spectrum Analyzer

Note: Conduct experiments (9-12) using MATLAB software. Student has to perform minimum twelve Experiments

Course Code	PCB DESIGN		L	T	P	C
21A040701			1	0	2	2
Pre-requisite	NIL	Semester	IV			

COURSE OBJECTIVES:

- To understand the concepts of single and multilayer Printed Circuit Board (PCB) design
- To make students capable to design their own projects PCB up to industrial grade

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Demonstrate the basics of PCB designing.

CO2: Make a Schematic of academic and industrial projects

CO3: Apply advance techniques, skills, and modern tools for designing and fabrication of PCBs.

CO4: Design the PCB for basic and analog electronic circuits.

CO-PO MAPPING:

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

TOPICS TO BE COVERED:

Introduction to PCB designing concepts: Introduction to PCB design, Difference between PWB and PCB, Types of PCBs: Single Sided (Single Layer), Multi-Layer (Double Layer), PCB Materials

Introduction to Electronic design Automation (EDA): Brief History of EDA, Latest Trends in Market, Different EDA tools, Introduction to SPICE and PSPICE Environment, Introduction and Working of PROTEUS

Component introduction and their categories: Types of Components, Active Components (Diode Transistor, MOSFET, LED, SCR, Integrated Circuits), Passive Components (Resistor, Capacitor, Inductor, Transformer, Speaker/Buzzer), Component Package Types

Introduction to Development Tools: Introduction to PCB Design using OrCAD tool, Introduction to PCB Design using PROTEUS tool

Detailed description and practical of PCB designing: PCB Designing Flow Chart, Schematic Entry, Net listing, PCB Layout Designing, Prototype Designing, PCB Making –Printing, Etching, Drilling, Assembly of components

Description of PCB Layers: Electrical Layers: Top Layer, Mid Layer, Bottom Layer, Mechanical Layers- Board Outlines and Cutouts, Drill Details, Documentation Layers - Components Outlines, Reference Designation, Text

Keywords & Their Description: Footprint, Pad stacks, Vias, Tracks, Color of Layers, PCB Track Size Calculation Formula, Rules for Track

LABORATORY EXPERIMENTS:

1. Understanding the schematic Entry, Creating Library & Components
2. Drawing a Schematic, Flat Design / hierarchical Design
3. Setting up Environment for PCB and Design a Board
4. Auto routing -Setting up Rules, Defining Constraints, Auto router Setup
5. PCB Designing of Basic and Analog Electronic Circuits
6. PCB Designing of Power Supplies
7. PCB Designing of Different Sensor modules
8. PCB Designing of Electronics Projects
9. Post Designing & PCB Fabrication Process - Printing the Design, Etching, Drilling,
10. Interconnecting and Packaging electronic Circuits (IPC) Standards
11. Gerber Generation
12. Soldering and De-soldering
13. Component Mounting
14. PCB and Hardware Testing

Project work:

- Making the schematic of Academic and Industrial projects
- PCB Designing of these projects
- Soldering and De-soldering of components as per Design
- Testing and Troubleshooting

Course Code	ELECTROMAGNETIC WAVES AND TRANSMISSION LINES		L	T	P	C
21A040412			3	0	0	3
Pre-requisite	Differential Equations & Vector Calculus	Semester	V			

COURSE OBJECTIVES:

- To introduce fundamentals of static and time varying electromagnetic fields.
- To teach problem solving in Electromagnetic fields using vector calculus.
- To demonstrate wave concept with the help of Maxwell's equations.
- To introduce concepts of polarization and fundamental theory of electromagnetic waves in transmission lines and their practical applications.
- To analyze reflection and refraction of electromagnetic waves propagated in normal and oblique incidences.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain the basics of vector analysis, coordinate systems and electrostatic fields. **(K3)**
CO2: Solve the problems of magnetostatics. **(K3)**
CO3: Analyze the boundary conditions of electromagnetic fields at the interface of different media using Maxwell's equations **(K4)**
CO4: Analyze electromagnetic wave propagation in different media. **(K4)**
CO5: Explain the concept of transmission lines and their applications. **(K4)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Electrostatics: Review of Vector algebra, Co-ordinate systems, Vector calculus, Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations, Capacitance – Parallel Plate, Coaxial, Spherical Capacitors, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand basic laws of static electric fields. (L2)
- Derive the Maxwell's equations for electrostatic fields. (L3)
- Solve problems applying laws of electrostatics. (L3)

- Apply the laws of electrostatics. (L3)

UNIT – II (8 Hrs)

Magnetostatics: Biot-Savart Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magneto static Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law, Inductances and Magnetic Energy, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the basic laws of static magnetic fields. (L2)
- Derive the Maxwell's equations for magnetic fields. (L3)
- Solve problems applying laws of magneto statics. (L3)
- Apply the laws of magnetostatics. (L3)

UNIT – III (8 Hrs)

Maxwell's Equations (for Time Varying Fields): Faraday's Law and Transformer e.m.f., Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements. Boundary Conditions of Electromagnetic fields: Dielectric-Dielectric and Dielectric-Conductor Interfaces, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the basic of Maxwell's Equations. (L2)
- Derive the Maxwell's equations for electromagnetic fields. (L3)
- Analyze the boundary conditions of electromagnetic fields at the interface of different media. (L4)

UNIT – IV (10 Hrs)

EM Wave Characteristics: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, Relation between E & H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics – Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Polarization, Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Theorem – Applications, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts of EM wave characteristics. (L2)
- Understand the concept of power flow using Poynting theorem. (L2)
- Derive wave equations for different media. (L3)
- Analyze the concept of wave propagation through the Maxwell's equations. (L4)
- Analyze concept of polarization of electromagnetic wave. (L4)

UNIT – V (9 Hrs)

Transmission Lines: Types, Transmission line parameters (Primary and Secondary), Transmission line equations, Input impedance, Standing wave ratio & power, Smith chart & its applications, Applications of transmission lines of various lengths, Microstrip transmission lines, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the principles of transmission lines and concept of smith chart (L2)
- Derive the input impedance of transmission line (L3)
- Solve the transmission line parameters (L3)
- Analyze the transmission lines of different lengths (L4)

TEXTBOOKS:

1. "Elements of Electromagnetics", Matthew N.O. Sadiku, Oxford Univ. Press, 4th Edition, 2008.
2. "Engineering Electromagnetics", William H. Hayt Jr. and John A. Buck, TMH, 7th Edition, 2006.

REFERENCE BOOKS:

1. "Electromagnetic Waves and Radiating Systems", E.C. Jordan and K.G. Balmain, PHI, 2nd Edition, 2000.
2. "Electromagnetics", John D. Krauss, McGraw- Hill publication, 4th Edition, 1999.
3. "Electromagnetics", Schaum's outline series, Tata McGraw-Hill publications, 2nd Edition, 2006.

ONLINE LEARNING RESOURCES:

1. https://www.onlinecourses.nptel.ac.in/noc21_ee53/preview
2. https://www.nptel.ac.in/courses/108106152

Course Code	INTEGRATED CIRCUITS AND APPLICATIONS		L	T	P	C
21A040413			3	0	0	3
Pre-requisite	Pulse and Digital Circuits	Semester	V			

COURSE OBJECTIVES:

- To understand DC and AC characteristics of operational amplifiers & Op amp parameters and functionality of specialized ICs such as 555 TIMER, VCO, PLL & Voltage regulators.
- To design circuits for various applications using Op-Amps and specialized ICs.
- To analyze Op-Amp based Comparators, Waveform generators, Active filters, Converters.
- To design of Op-Amp based Comparators, Waveform Generators, Active filters, Converters, design various multi-vibrator circuits using IC 555 timer.
- To analyze different types of A/D and D/A Converter circuits.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain the construction and characteristics of ideal and practical operational amplifiers. **(K3)**
CO2: Analyze linear applications using Op-Amp. **(K4)**
CO3: Analyze Op-Amp based non-linear applications and waveform generators. **(K4)**
CO4: Compare data converter (ADC and DAC) Circuits using Op-Amps. **(K5)**
CO5: Construct different applications of special purpose IC's such as 555 Timer, 566 VCO, 565 PLL **(K3)**

CO-PO MAPPING:

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

UNIT – I (11 Hrs)

Operational Amplifier: Introduction, Block diagram, Characteristics and Equivalent circuits of an ideal Op-Amp, Various types of Operational Amplifiers and their applications, Power supply configurations for OP-AMP applications, Inverting and non-inverting amplifier configurations. The Practical Op-Amp: Introduction, Input offset voltage, Offset current, Thermal drift, Effect of variation in power supply voltage, common-mode rejection ratio, Slew rate and its Effect, PSRR and Gain – bandwidth product, frequency limitations and compensations, transient response.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the construction and working of Op-Amp. (L2)
- Compare Op-Amp open loop and closed loop configurations. (L2)
- Identify different offsets present in Op-Amp and provide nullification. (L2)
- Compare ideal and practical Op-Amps characteristics. (L3)

UNIT – II (10 Hrs)

Applications of Operational Amplifier: Amplifiers: Adder, Integrator, Differentiator, Difference amplifier and Instrumentation amplifier, Converters: Current to voltage and voltage to current converters, Active Filters: First order filters, second order active finite and infinite gain low pass, high pass, band pass and band reject filters.

Learning Outcomes: At the end of this unit, students should be able to

- Describe operation of Op-Amp based Linear application circuits, converters, amplifiers. (L2)
- Design circuits such as amplifiers, comparator, differentiators and integrators using operational amplifiers for various applications. (L3)
- Design active filters using Op amp for given specifications. (L3)

UNIT – III (8 Hrs)

Non-Linear Applications of Operational Amplifier: Comparators: Inverting comparator, non-inverting comparator, zero crossing detector, window detector and level detector, Schmitt Triggers: Inverting Schmitt trigger, non-inverting Schmitt trigger with adjustable threshold levels. Precision Rectifiers: Half and full wave precision, rectifiers, log and antilog amplifiers, voltage to frequency converter, frequency to voltage converter.

Waveform Generators: Sine Wave Oscillators: RC phase shift oscillator, Wien bridge oscillator, Square wave and triangular wave generator with duty cycle modulation.

Learning Outcomes: At the end of this unit, students should be able to

- Describe operation of Op-Amp based comparators, converters, detectors, rectifiers and waveform generators. (L2)
- Analyse Op-Amp based Comparators, converters, detectors, rectifiers and waveform generators. (L4)
- Design Waveform generators, voltage to frequency converters & frequency to voltage converters for given specification. (L3)

UNIT – IV (7 Hrs)

Data Converters: Introduction, Basic DAC techniques, Different types of DACs-Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different Types of ADCs - Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC. Dual Slope ADC, DAC and ADC Specifications.

Learning Outcomes: At the end of this unit, students should be able to

- Compare different types of A/D & D/A converter circuits. (L5)
- Explain operating principles of different A/D & D/A converters. (L3)
- Examine ADC & DAC specifications to select the right converter for an application. (L3)

UNIT – V (9 Hrs)

Special Purpose Integrated Circuits: Functional block diagram, working, design and applications of Timer 555 (Monostable & Astable), Functional block diagram, working and applications of VCO 566, PLL 565, Fixed and variable Voltage regulators.

Learning Outcomes: At the end of this unit, students should be able to

- Describe the operation of 555 timer, IC voltage regulators. (L2)
- Describe functionality of special purpose ICs such as VCO, PLL. (L2)
- Construct multi-vibrator circuits using timer. (L3)

TEXTBOOKS:

1. "Op-Amps & Linear ICs", Ramakanth A. Gayakwad, 4th Edition, Pearson, 2017.
2. "Linear Integrated Circuits", D. Roy Choudhury, 2nd Edition, New Age International (p) Ltd, 2003.

REFERENCE BOOKS:

1. "Integrated Electronics - Analog and Digital circuits system", Jacob Millman, Christos C. Halkias, Tata McGraw Hill, 2003.
2. "Design with Operational Amplifiers & Analog Integrated Circuits", Sergio Franco, 3rd Edition, McGraw Hill, 1988.
3. "Analysis and Design of Analog Integrated Circuits", Gray and Meyer, 5th Edition, Wiley International, 2009.

Course Code	DIGITAL COMMUNICATIONS		L	T	P	C
21A040414			3	0	0	3
Pre-requisite	Probability Theory and Stochastic Processes, Signals & Systems, Analog Communications	Semester	V			

COURSE OBJECTIVES:

- To understand the key modules of digital communication systems with emphasis on digital modulation techniques.
- To get introduced to the concept and basics of information theory and the basics of source and channel coding/decoding.
- To prepare mathematical background for communication signal analysis.
- To study signal flow in a digital communication system.
- To analyze error performance of a digital communication system in presence of noise and other interferences.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Analyze different pulse modulation techniques & Distortions in communication systems. **(K4)**

CO2: Analyze the basic principles of baseband modulation schemes. **(K4)**

CO3: Analyze the different modulation & demodulation for pass band data transmission and their probability of error. **(K4)**

CO4: Compare the power bandwidth, bit error probability for various modulation schemes. **(K4)**

CO5: Apply different channel encoding techniques for error detection and correction. **(K3)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Source Coding Systems: Introduction, sampling process, quantization, quantization noise, conditions for optimality of quantizer, encoding, Pulse-Code Modulation (PCM), Line codes, Differential encoding, Regeneration, Decoding & Filtering, Noise considerations in PCM systems, Time-Division Multiplexing (TDM), Synchronization, Delta modulation (DM)-Granular noise Slope over distortion, Differential PCM (DPCM), Processing gain, Adaptive DPCM (ADPCM), Comparison of the above systems, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Discuss source coding techniques & pulse modulation techniques. (L2)

- Describe and determine the performance of line codes. (L2)
- Analyze different pulse modulation techniques & Distortions. (L4)
- Compare the performance of different pulse modulation Schemes. (L4)

UNIT – II (9 Hrs)

Baseband Pulse Transmission: Introduction, Matched filter, Properties of Matched filter, Matched filter for rectangular pulse, Error rate due to noise, Inter-symbol Interference (ISI), Nyquist's criterion for distortion less baseband binary transmission, ideal Nyquist channel, raised cosine filter & its spectrum, Correlative coding – Duo binary & Modified duo binary signaling schemes, Partial response signaling, Baseband M-ary PAM transmission, Eye diagrams, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Analyze the performance of baseband pulse transmission system. (L4)
- Describe the generation & detection of baseband modulated signals. (L2).
- Analyze probability of error for various baseband data transmission schemes. (L4)

UNIT – III (8 Hrs)

Signal Space Analysis: Introduction, Geometric representation of signals, Gram-Schmidt orthogonalization procedure, Response of bank of correlators to noisy input, Coherent detection of signals in noise - maximum likelihood decoder, Probability of error, Correlation receiver, detection of signals with unknown phase, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts of signal space analysis. (L2)
- Examine the characteristics of maximum likelihood decoder. (L3)
- Analyze correlation receiver. (L4)

UNIT – IV (9 Hrs)

Passband Data Transmission: Introduction, Passband transmission model, Coherent modulation schemes- Generation and detection of binary phase shift keying (BPSK), Quadrature shift keying (QPSK), and Binary Frequency shift keying (BFSK). Analysis of probability of error for BPSK, QPSK, BFSK, Power spectra of above-mentioned modulated signals. M-ary PSK, Mary quadrature amplitude modulation (M-ary QAM), Non-coherent orthogonal modulation schemes - Generation and detection of non-coherent BFSK, DPSK - analysis of probability of error and Comparison of power bandwidth requirements for all the above schemes, Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Analyse the different digital modulation techniques, generation and detection, power spectra and their probability of error performance. (L4)
- Compare the power bandwidth, bit error probability for various modulation scheme. (L4)

UNIT – V (9 Hrs)

Channel Coding: Discrete memory less channels, Linear Block Codes-Repetition codes, Syndrome decoding, minimum distance considerations, Cyclic codes- generator polynomial, parity check polynomial, encoder for cyclic code, calculation of syndrome, Convolutional Codes – generator polynomials, state diagrams, Viterbi algorithm, Illustrative problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various error control encoding and decoding techniques. (L2)
- Apply information theory and linear algebra in source coding and channel coding. (L3)
- Analyse the performance of error control codes. (L4)

TEXTBOOKS:

1. "Communication Systems", Simon Haykin, Wiley India Edition, 4th Edition, 2011.
2. "Modern Digital & Analog Communication Systems", B.P. Lathi, & Zhi Ding, 4th Edition, Oxford University Press, International 2010.

REFERENCE BOOKS:

1. "Digital and Analog Communication Systems", Sam Shanmugam, 3rd Edition, John Wiley, 2005.
2. "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", Bruce Carlson and Paul B. Crilly, 5th Edition, McGraw Hill International, 2010
3. "Microwave and Radar Engineering", M. Kulkarni, Umesh Publications, 4th Edition, 2009.
4. "Digital Communications", Bernard Sklar, 2nd edition, Prentice-Hall PTR, 2001.

ONLINE LEARNING RESOURCES:

1. https://nptel.ac.in/courses/117101051
2. https://www.sciencedirect.com/topics/engineering/digital-communication-system
3. https://www.mastersportal.com/disciplines/322/digital-communication.html

Course Code	DATA COMMUNICATION AND NETWORKING		L	T	P	C
21A040415			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- To provide a solid conceptual understanding about the data communication fundamentals and computer networking.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain the layers in ISO/OSI model and switching techniques in networks. **(K3)**
CO2: Analyze the functions of various Data link layer protocols. **(K4)**
CO3: Compare the various IEEE standards for LANs and WLAN **(K4)**
CO4: Explain the functions of various routing algorithms and IPvx protocols. **(K4)**
CO5: Analyze the functions of transport layer protocols and application layer protocols. **(K4)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Data Communications: Components, protocols and standards, Network and Protocol Architecture, Internet, Reference Model ISO-OSI, TCP/IP-Overview, topology, transmission modes, digital signals, digital data transmission, transmission impairment, Data rate limits, Performance, wavelength and Shannon capacity, digital to digital encoding, transmission media: guided and unguided, Modems, cable modem

Switching: Circuit switching (space-division, time division and space-time division), packet switching (virtual circuit and Datagram approach), message switching.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the fundamentals of data communication systems and transmission media. (L2)
- Explain the layers in ISO-OSI Model and TCP/IP. (L3)
- Illustrate the various switching techniques in networks (L3)

UNIT – II (10 Hrs)

Data Link Layer: Review of Error Detection and Correction codes, Design issues, Data Link Control and Protocols: Flow and Error Control, Stop-and wait ARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, Point-to – Point Access: Point –to- Point Protocol

Learning Outcomes: At the end of this unit, students should be able to

- Analyze the functions of various Data link layer protocols. (L4)
- Explain the functions of HDLC and Point to Point protocols (L3).

UNIT – III (8 Hrs)

Multiple Access: Channel allocation problem, Controlled Access, Channelization, multiple access protocols, IEEE standard 802.3 & 802.11 for LANs and WLAN, Token ring, Token Bus, FDDI based LAN, Network Devices - repeaters, hubs, switches, bridges.

Learning Outcomes: At the end of this unit, students should be able to

- Apply the multiple access techniques for various networks (L3)
- Compare the various IEEE standards for LANs and WLAN (L4)
- Understand the role of connecting devices in networks (L2)

UNIT – IV (9 Hrs)

Network Layer: Design issues, Unicast Routing algorithms, Host to Host Delivery: Internetworking, IP addressing (Classfull & Classless), Subnet, Network Layer Protocols: ARP, IPV4, ICMP, IPV6.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the various routing algorithms (L3).
- Understand the concepts of network layer protocols (L2).
- Apply the IP addresses to systems in any network (L3).

UNIT – V (9 Hrs)

Transport Layer: Process to Process Delivery: UDP; TCP, congestion control and Quality of service.

Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP), file transfer (FTP), HTTP and WWW

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts of process to process delivery, congestion control and QOS (L2).
- Distinguish between the connection oriented and connection less transport protocols (L4).
- Analyze the functions of Application layer protocols (L4).

TEXTBOOKS:

1. "Data Communications and Networking", Behrouz A. Forouzan, Tata McGraw-Hill, 4^{th} Edition
2. "Computer Networks", S. Tannenbum, D. Wetherall, Prentice Hall, Pearson, 5^{th} Edition

REFERENCE BOOKS:

1. "Computer Networks", Fred Halsall, Addison - Wesley Publication. Co., 1996.
2. "Computer Networks: A system Approach", Larry L, Peterson and Bruce S. Davie, Elsevier, 4th Edition.
3. "Introduction to Data Communications & Networking", Wayne Tomasi, Pearson Education, 7th Edition, 2011
4. "Data and Computer Communications", William Stallings, Prentice Hall, Imprint of Pearson, 9th Edition.

ONLINE LEARNING RESOURCES:

1. https://ocw.mit.edu/courses/6-263j-data-communication-networks-fall-2002/
2. https://www.ibm.com/topics/networking
3. https://skillsforall.com/course/networking-basics?utm_medium=referral&utm_source=cisco.com&utm_campaign=writ&utm_content=networking-basics_coursepage&utm_team=field_global

Course Code	ELECTRONIC MEASUREMENTS & INSTRUMENTATION		L	T	P	C
21A040416			3	0	0	3
Pre-requisite	Electronic Devices and Circuits	Semester	V			

COURSE OBJECTIVES:

- To provide an understanding of various measuring systems functioning and metrics for performance analysis.
- To provide an understanding of principle of operation, working of different electronic instruments viz. signal generators, signal analysers, recorders and measuring equipment.
- To provide an understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Apply the knowledge of DC and AC meters while solving problems related to measurement errors. **(K4)**

CO2: Analyze the performance of various CROs. **(K4)**

CO3: Analyze the performance various signal generators and analysers. **(K4)**

CO4: Compare different types of bridge circuits. **(K4)**

CO5: Measure various physical parameters by appropriately selecting the transducers. **(K5)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Performance characteristics of Instruments: Static characteristics, Accuracy, Precision, Resolution, Sensitivity, static and dynamic calibration, Errors in Measurement, and their statistical analysis, dynamic characteristics-speed of Response, fidelity, Lag and dynamic error. DC ammeters, DC voltmeters, AC voltmeters Thermocouple type RF ammeter, ohmmeters -series type, shunt type, Multimeter for voltage, current and resistance measurements, illustrative problems.

Learning Outcomes: At the end of this unit, students should be able to

- Remember different terms used for characterizing the performance of an instrument / measurement system (L1)
- Understand the principle of operation of various meters (L2)
- Apply the knowledge of DC and AC meters while solving problems related to measurement errors (L3)

UNIT – II (9 Hrs)

Oscilloscopes: Standard specifications of CRO, CRT features, vertical and horizontal amplifiers, horizontal and vertical deflection systems, sweep trigger pulse, delay line, sync selector circuits, probes for CRO – active, passive and attenuator type, dual trace/beam CRO, Principles of sampling oscilloscope, storage oscilloscope, and digital storage oscilloscope, Digital frequency counters, time & Period measurements.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the basic principles of CROs (L2)
- Analyze the performance of various CROs (L4)

UNIT – III (8 Hrs)

Signal Generators and Analyzers: Fixed and variable frequency AF oscillators, function generators, pulse, random noise, sweep, and arbitrary waveform generators, their standards, specifications and principles of working (Block diagram approach); Wave analyzers, Harmonic distortion analyzers, Spectrum analyzers, and Logic analyzers.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the basic principle of various signal generators and analyzers (L1)
- Describe characteristics of signal generators and analyzers (L2)
- Distinguish principles of working of wave analyzer and spectrum analyzer (L4)

UNIT – IV (8 Hrs)

Bridges: Wheatstone bridge, Wein Bridge, errors and precautions in using bridges, AC bridges: Measurement of inductance-Maxwell's bridge, Anderson Bridge. Measurement of capacitance- Schearing Bridge, Kelvin Bridge, Q-meter, EMI and EMC, Interference and noise reduction techniques.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the basic principle of various bridges (L2)
- Compare different types of bridge circuits (L4)

UNIT – V (10 Hrs)

Sensors and Transducers: Active and passive transducers: Measurement of displacement (Resistance, capacitance, inductance; LVDT) Force (strain gauges) Pressure (piezoelectric transducers) Temperature (resistance thermometers, thermocouples, and thermistors), Velocity, Acceleration, Vibration, pH measurement.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the basic principle of sensors and transducers (L1)
- Explain working principle of various transducers and sensors (L2)
- Select the appropriate sensor/transducer for the measurement of physical parameters (L5)

TEXTBOOKS:

1. "Modern Electronic Instrumentation and Measurement Techniques", D. Helfrick, W.D. Cooper, 2nd Edition, Pearson Education India, 2015.
2. "Electronic Instrumentation", H. S. Kalsi, 3rd Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS:

1. "Electronic Instrumentation and Measurements", David A. Bell, Oxford University Press, 2007.
2. "Electronic Measurements and Instrumentation", B.M. Oliver, J.M. Cage, TMH Reprint 2009.
3. "Measurement Systems", Ernest O. Doebelin and Dhanesh N Manik, 6th Edition, TMH, 2010.

ONLINE LEARNING RESOURCES:

1. https://en.wikipedia.org/wiki/PH_meter

Course Code	CONCEPTS OF MACHINE LEARNING		L	T	P	C
21A040417			3	0	0	3
Pre-requisite	Probability Theory & Stochastic Processes	Semester	V			

COURSE OBJECTIVES:

- Gain knowledge about basic concepts of Machine learning
- Understand various key paradigms for machine learning approaches
- Understand a range of machine learning algorithms along with their strengths and weaknesses.
- Understand different computational learning theory.
- Differentiate among various machine learning techniques.

COURSE OUTCOMES:

After completion of the course, students will be able to

CO1: Understand and Identify machine learning techniques suitable for a given problem **(K2)**

CO2: Analyze and compare the various learning algorithms **(K4)**

CO3: Solve the problems using various machine learning techniques **(K3)**

CO4: Analyze the concept of neural networks for learning linear and non-linear activation functions **(K4)**

CO5: Understand the concepts in Bayesian analysis from probability models and methods **(K2)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction: Learning Problems – Perspectives and Issues – Concept Learning, Goals and applications of machine learning, Aspects of developing a learning system: training data, concept representation, function approximation.

Inductive Classification: The concept learning task, Concept learning as search through a hypothesis space, General-to-specific ordering of hypotheses, Finding maximally specific hypotheses, Version spaces and the candidate elimination algorithm, Learning conjunctive concepts, The importance of inductive bias.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various key paradigms for machine learning approaches (L2)
- Learn the basics of learning problems with hypothesis and version spaces (L1)

UNIT – II (9 Hrs)

Decision Tree Learning: Representing concepts as decision trees, Issues in Decision tree learning, Recursive induction of decision trees, picking the best splitting attribute: entropy and information gain, searching for simple trees and computational complexity, Occam's razor, Over fitting, noisy data, and pruning.

Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of Decision tree learning and their issues. (L2)
- Understand the basic theory underlying machine learning (L2).

UNIT – III (9 Hrs)

Computational Learning Theory: Models of learnability: learning in the limit; probably approximately correct (PAC) learning. Sample complexity for infinite hypothesis spaces, Vapnik – Chervonenkis dimension.

Rule Learning: Propositional and First-Order, Translating decision trees into rules, Heuristic rule induction using separate and conquer and information gain, First-order Horn-clause induction (Inductive Logic Programming) and Foil, Learning recursive rules, Inverse resolution, Golem, and Progol

Learning Outcomes: At the end of this unit, students should be able to

- Explain a very broad collection of computational learning algorithms and problems (L3)
- Develop an appreciation for what is involved in learning from data. (L4)

UNIT – IV (9 Hrs)

Artificial Neural Networks: Neurons and biological motivation, Linear threshold units. Perceptrons, representational limitation and gradient descent training, Multilayer networks and back propagation, Hidden layers and constructing intermediate, distributed representations. Over fitting, learning network structure, recurrent networks.

Support Vector Machines: Maximum margin linear separators. Quadratic programming solution to finding maximum margin separators, Kernels for learning non-linear functions.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the Neural Networks and its usage in machine learning application. (L2).
- Characterize the machine learning algorithms as supervised learning and unsupervised learning, apply and analyze the various algorithms of supervised and unsupervised learning (L3).

UNIT – V (9 Hrs)

Bayesian Learning: Probability theory and Bayes rule. Naive Bayes learning algorithm, Parameter smoothing, Generative vs. discriminative training, Logistic regression, Bayes nets and Markov nets for representing dependencies.

Instance-Based Learning: Constructing explicit generalizations versus comparing to past specific examples. K-Nearest-neighbor algorithm, Case-based learning.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the features of machine learning to apply on real world problems (L2).
- Design application using machine learning techniques (L3).

TEXTBOOKS:

1. "Machine Learning", T.M. Mitchell, McGraw-Hill, 1997.
2. "Machine Learning", Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 2019.

REFERENCE BOOKS:

1. "Introduction to Machine Learning", Ethern Alpaydin, MIT Press, 2004.
2. "Machine Learning -An Algorithmic Perspective", Stephen Marsland, 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014
3. "Introduction to Machine Learning with Python: A Guide for Data Scientists", Andreas C. Müller and Sarah Guido, Oreilly
4. "Pattern Recognition and Machine Learning", Christopher Bishop

ONLINE LEARNING RESOURCES:

1. https://www.deeplearning.ai/machine-learning-yearning/
2. https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html
3. http://nptel.ac.in/courses/106106139/

Course Code	INTEGRATED CIRCUITS AND APPLICATIONS LAB		L	T	P	C
21A040418			**0**	**0**	**3**	**1.5**
Pre-requisite	Pulse and Digital Circuits	Semester	V			

COURSE OBJECTIVES:

- To understand the working of Op amp ICs & Application specific analog ICs.
- To design Operational amplifiers for linear and nonlinear application, Multivibrator circuits using 555 & application specific ICs.
- To simulate linear and nonlinear application-based Op amp Circuits and circuits based on application specific ICs.
- To compare theoretical, practical & simulated results in integrated circuits.
- To analyze operational amplifier based circuits for linear and non-linear applications.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Design and test the performance of Operational amplifier applications. **(K5)**

CO2: Construct and study comparator, Schmitt trigger, Signal converters, rectifiers, Logarithmic amplifier and Instrumentation amplifier, R-2R DAC using Op-Amp. **(K3)**

CO3: Design and test the performance of 2nd and 3rd order active filters. **(K5)**

CO4: Design and verify the operation of astable and monostable circuits using 555 timer. **(K5)**

CO5: Test the functionality of different ICs 565, 78XX/79XX and LM723. **(K5)**

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. Applications of Op-Amp
   Design and test the performance of the following circuits using Op-Amp IC741/TL082
   a. Inverting amplifier
   b. Non-inverting amplifier
   c. Voltage follower
   d. Summer
2. Design and test the performance of practical differentiator and integrator circuits for various time constants. Plot the graphs.

3. Comparator circuits
   Construct comparator with variable reference voltages and Schmitt trigger using Op-Amp.
4. Signal converters
   Construct suitable circuits for Voltage to Current and Current to Voltage converters using Op-Amp.
5. Active filters using Op-Amp
   Design and test the performance of 2nd and 3rd order Butterworth LPF and HPF.
6. Active filters using Op-Amp
   Design and test the performance of 2nd order Butterworth BPF and BSF.
7. Construct and verify the performance of
   a. Logarithmic and antilog amplifiers b. Instrumentation amplifier
8. Precision rectifiers
   Conduct experiments on half wave and full wave precision rectifiers and draw the output waveforms.
9. Design the monostable multivibrator circuit and verify their performance practically using IC 555.
10. Design the astable multivibrator circuit and verify their performance practically using IC 555.
11. Data converters
    Construct and study performance of
    a. DAC circuits – R-2R and ladder type.
    b. Successive approximation type ADC.
12. Test the performance of PLL IC565.
13. Design a DC power supply using 78XX/79XX andLM723, verify the same practically.

SOFTWARE REQUIRED:

1. Multisim/ Pspice/Equivalent simulation software tool

Note:

1. At least 12 experiments from the above list shall be performed. Out of them any 4 experiments should be conducted using software tools.
2. All the Hardware experiments may be performed using ICs 741, TL082, 555,565

Course Code	**DIGITAL COMMUNICATIONS LAB**		**L**	**T**	**P**	**C**
21A040419			**0**	**0**	**3**	**1.5**
Pre-requisite	Signals & Systems, Analog Communications	Semester	V			

COURSE OBJECTIVES:

- To develop skills for performance analysis of practical digital communication systems.
- To understand the fundamental concepts on TDM, Pulse modulation & digital modulation techniques.
- To evaluate the performance of PCM, DPCM and DM in a digital communication system.
- To learn how to use MATLAB software and hardware effectively and creatively to synthesis digital communication systems.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain real time behavior of different digital modulation schemes and technically visualize spectra of different digital modulation schemes. **(K3)**

CO2: Analyze digital modulation & demodulation techniques. **(K4)**

CO3: Design and implement different modulation and demodulation techniques. **(K4)**

CO4: Simulate digital modulation and demodulation techniques in MATLAB. **(K3)**

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

HARDWARE EXPERIMENTS (PART – A)

1. Study and verify the sampling theorem.
2. Verify Time division multiplexing circuit to multiplex three users' data.
3. Verify the functionality of each block in Pulse code modulation system practically.
4. Verify the functionality of each block in a Differential pulse code modulation circuit experimentally.
5. Verify the operation of Delta modulation and demodulation.
6. Verify modulated and demodulated circuit for Frequency shift keying.
7. Verify a modulated and demodulated circuit for Differential phase shift keying.

SOFTWARE EXPERIMENTS (PART-B)

1. Study Sampling Theorem and verify the effect of under sampling and oversampling while retrieving the original signal.
2. Understand functioning of each block in Pulse code modulation circuit and verify through simulation.
3. Write a program on Differential pulse code modulation and demodulation.
4. Write a program on Frequency shift keying modulation schemes for given two carrier frequencies.
5. Write a program and verify QPSK modulation and demodulation, determine the bit error probability.
6. Write a program and verify Differential phase shift keying modulation scheme is a non-coherent modulation scheme, determine the bit error probability.
7. Design and verify working principle of BPSK modulation and demodulation through simulation.

<u>SOFTWARE REQUIRED:</u>

1. MATLAB / Equivalent Software

Note: Minimum of Twelve experiments are to be conducted (any six from each part)

Course Code	PROGRAMMING ARDUINO		L	T	P	C
21A040702			1	0	2	2
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- To acquire knowledge on different Smart System applications using Arduino.
- To familiarize with Arduino boards, IDE, programming language & platform.
- To acquire knowledge on Arduino boards and basic components.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain the basics of programming Arduino. **(K3)**
CO2: Design the prototype circuits and connect them to the Arduino. **(K6)**
CO3: Apply the Programming concept of Arduino microcontroller to develop the circuits. **(K3)**
CO4: Develop skills to design and implement various smart system application. **(K3)**

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

Module-1: Arduino:

- Introduction to Arduino
- Pin configuration and architecture.
- Device and platform features.
- Concept of digital and analog ports.
- Familiarizing with Arduino Interfacing Board
- Introduction to Embedded C and Arduino platform

Module-2: Arduino Displays

- Working with Serial Monitor
- Line graph via serial monitor
- Interfacing a 8 bit LCD to Arduino
- Fixed one-line static message display.
- Running message display.
- Using the LCD Library of Arduino.

Module-3: Arduino Sensors

- Arduino – Humidity Sensor
- Arduino – Temperature Sensor
- Arduino – Water Detector / Sensor
- Arduino – PIR Sensor
- Arduino – Ultrasonic Sensor
- Arduino – Connecting Switch (Magnetic relay switches)

Case Study-1: Control Light & Fan with Clap using Arduino

Design a IoT application which controls the home appliances like Fan, TV, light and etc using sound effect. This project is very useful for elderly and differently abled persons to control their room with depending one other. Source link: https://www.youtube.com/watch?v=hzUFnP3Xt7c

Case Study -2: Rain Alert System using Arduino

Design a system to alert the people when is raining. This system is very useful for vehicles to switch on the wipers as well as many places where the device working based on rain.
Source link: https://www.youtube.com/watch?v=YlIH1ti4Vy0

Case Study -3: Theft Alert System using Arduino

Design a system to alert the people using IR sensor when the motion is detected. This system is useful for high security areas. Source link: https://www.youtube.com/watch?v=zOmsl-dTq8M

Case Study-4: Water Level Meter using Water Level Sensor

Design a sensor which can sense the water level in tanks where the motor pumps are used. There is no specific method to check the level of the water. Use water level sensor or Ultrasonic sensor to design this system. Source Link: https://www.youtube.com/watch?v=n7WRi5U5lQk

Case Study-5: Arduino Funny Jumper Game

Design a Funny Jumper game using an Arduino Uno and 16 x2 LED display. The main objective of this game is to gain the highest score. This game is an interesting addictive fun game. This is a one button human vs Arduino game uses a push button for jumping. The game ends whenever the player fails to jump when obstacle arrives. Two or more players can play the game in turn-wise and use some strategy to win the game. Source Link: https://youtu.be/flC3_X-yJ-I

TEXTBOOKS:

1. “Programming Arduino: Getting Started with Sketches”, Simon Monk, McGraw Hill TAB, 2nd Edition, 2016.
2. “Programming and Interfacing with Arduino”, Yogesh Misra, CRC Press, 1st Edition, 2021.

REFERENCE BOOKS:

1. "Getting Started with Arduino", Massimo Banzi, O'Reilly Media, Incorporated, 2nd Edition, 2011.
2. "Internet of Things with Raspberry Pi and Arduino", Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, CRC Press, 2019.

ONLINE LEARNING RESOURCES:

1. https://www.tutorialspoint.com/arduino/index.htm
2. https://create.arduino.cc/projecthub
3. https://create.arduino.cc/projecthub/projects/tags/arduino

Course Code	UNIVERSAL HUMAN VALUES (Common to all branches)		L	T	P	C
21A000003			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Identify the significance and need of values in the society. **(K2)**

CO2: Understand the meaning of Harmony in the Self the Co-existence of Self and Body. **(K2)**

CO3: Understanding the value of harmonious relationships and explore their role in ensuring a harmonious society **(K2)**

CO4: Examine the harmony in nature and existence, and work out their mutually fulfilling participation in the nature. **(K3)**

CO5: Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work. **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations.

Learning Outcomes: At the end of this unit, students should be able to

- Identify the significance and need of values in the society. (L2)

UNIT – II (9 Hrs)

Understanding Harmony in the Human Being - Harmony in Myself: Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programs to ensure self-regulation and Health.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the meaning of Harmony in the Self the Co-existence of Self and Body. (L2)
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. (L2)

UNIT – III (9 Hrs)

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship: Harmony in the Family – the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order

Learning Outcomes: At the end of this unit, students should be able to

- Understanding the value of harmonious relationships and explore their role in ensuring a harmonious society (L2)

UNIT – IV (9 Hrs)

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at all Levels, and the Holistic Perception of Harmony in Existence.

Learning Outcomes: At the end of this unit, students should be able to

- Examine the harmony in nature and existence, and work out their mutually fulfilling participation in the nature. (L3)

UNIT – V (9 Hrs)

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

Learning Outcomes: At the end of this unit, students should be able to

- Identify the scope and characteristics of people friendly and eco-friendly production systems. (L2)
- Develop appropriate technologies and management patterns for above production systems. (L3)

- Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work. (L3)

TEXTBOOKS:

1. "A Foundation Course in Human Values and Professional Ethics", R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.
2. "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2.

REFERENCE BOOKS:

1. "Jeevan Vidya: Ek Parichaya", A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. "Human Values", A. N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. "The Story of My Experiments with Truth", Mohandas Karamchand Gandhi
5. "Small is Beautiful", E. FSchumacher.
6. "Slow is Beautiful", Cecile Andrews
7. "Economy of Permanence", J C Kumarappa
8. "Bharat Mein Angreji Raj", Pandit Sunderlal
9. "Rediscovering India", Dharampal,
10. "Hind Swaraj or Indian Home Rule", Mohandas K. Gandhi,
11. "India Wins Freedom", Maulana Abdul Kalam Azad
12. "Vivekananda", Romain Rolland (English)
13. "Gandhi", Romain Rolland (English)

ONLINE LEARNING RESOURCES:

1. http://www.uhv.org.in/
2. https://vvce.ac.in/wp-content/uploads/2021/04/Realising-Aspirations-of-NEP2020-UHV.pdf
3. https://www.studocu.com/in/document/dr-apj-abdul-kalam-technical-university/universal-human-valuestechnical-communication/uhv-best-notes/31376289

Course Code	ANTENNAS & MICROWAVE ENGINEERING		L	T	P	C
21A040420			3	0	0	3
Pre-requisite	Electromagnetic Waves and Transmission Lines	Semester	VI			

COURSE OBJECTIVES:

- To enable the student to understand the basic principles in antenna and microwave system design
- To make the student to acquire knowledge in the area of various antenna designs.
- To enhance the student knowledge in the area of microwave components and antenna for practical applications.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Learn about the basics of antenna parameters & radiation patterns. **(K3)**
CO2: Design and analyse VHF, UHF and Microwave antennas. **(K4)**
CO3: Understand the uses of antenna arrays and analyze waveguides and resonators. **(K4)**
CO4: Analyse various microwave Components and understand the principles of various microwave sources. **(K4)**
CO5: Understand the working of various microwave solid state devices. **(K3)**

MAPPING WITH COs & POs:

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

UNIT – I (9 Hrs)

Antenna Basics &Wire Antennas: Definition of antenna, Radiation Mechanism – single wire, two wire, dipoles, Antenna Parameters - Radiation Patterns, Main Lobe and Side Lobes, Beam widths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Aperture Efficiency, Effective Height and length, Radiation from Small Electric Dipole, Quarter wave Monopole and Half wave Dipole – Current Distributions, Field Components, Radiated power, Radiation Resistance, Introduction to Loop Antennas, Arrays with Parasitic Elements - Yagi - Uda Arrays, Folded Dipoles & their characteristics.

Learning Outcomes: At the end of this unit, students should be able to

- Understand radiation mechanism and basic antenna characteristics. (L1)
- Compute radiation intensity, gain and directivity of antennas. (L2)

UNIT – II (8 Hrs)

VHF, UHF and Microwave Antennas : Helical Antennas-Helical Geometry, Helix modes, Horn Antennas- Types, Fermat's Principle, Optimum Horns, Design considerations of Pyramidal Horns, Micro strip Antennas- Introduction, features, advantages and limitations, Rectangular patch antennas- Geometry and parameters, characteristics of Micro strip antennas, reflector antennas - Introduction, corner reflectors, parabola reflectors- geometry, pattern characteristics, Feed Methods, Introduction to Lens Antennas

Learning Outcomes: At the end of this unit, students should be able to

- Describe feeding methods for microstrip antennas. (L2)
- Design rectangular and circular patch antenna for given specifications. (L4)

UNIT – III (11 Hrs)

Antenna Arrays and propagation: Arrays of 2 Isotropic sources- Different cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their characteristics and comparison, Binomial Arrays, Different modes of wave propagation, Ground wave propagation, Space wave propagation - Sky wave propagation (Qualitative treatment).

Waveguides: Introduction, Rectangular waveguides, Field expressions for TE and TM modes, Wave propagation in the guide, Phase and group velocities, Circular Waveguide – TE and TM modes (Qualitative Treatment), waveguide resonators.

Learning Outcomes: At the end of this unit, students should be able to

- Derive expressions for radiation resistance, directivity of wire antenna, (L3)
- Obtain radiation pattern of various array antennas using pattern multiplication. (L3)
- To know the design aspects of antenna arrays. (L4)
- Derive field expressions for different modes propagation in the waveguides. (L3)

UNIT – IV (10 Hrs)

Passive Microwave Devices: Introduction to scattering parameters and their properties, Terminations, Variable short circuit, Attenuators, Phase shifters, Hybrid Tees (H-plane, E-plane, Magic Tees), Hybrid ring, Directional Couplers – Bethe hole and Two-hole Couplers, Microwave propagation in Ferrites, Microwave devices employing Faraday rotation – Isolator, Circulator, Deriving Scattering matrix for Microwave passive devices.

Microwave Amplifiers and Oscillators: Microwave Tubes: Linear Beam Tubes – Two cavity Klystron amplifier -velocity modulation, bunching process, output power, Reflex Klystron oscillator, power output and efficiency, Travelling Wave Tube (TWT) – Bunching process and amplification process (Qualitative treatment only). Crossed Field Tubes – Magnetron oscillator.

Learning Outcomes: At the end of this unit, students should be able to

- Understand principle of operation of all passive microwave devices. (L1)
- Derive the scattering matrix for the microwave devices. (L3)
- Understand the principle of Microwave Tubes and semiconductor devices. (L1)
- Derive the expressions power output and efficiency of all microwave devices. (L3)

UNIT – V (7 Hrs)

Microwave Semiconductor Devices: Gunn Oscillator – Principle of operation, Characteristics, Two valley model, IMPATT, TRAPATT diodes.

Antennas and Microwave Measurements: Sources of errors, Patterns to be Measured, Pattern Measurement Arrangement, Directivity Measurement, Gain Measurements (by comparison, Absolute and 3-Antenna Methods). Description of Microwave bench-different blocks and their features, errors and precautions, Microwave power measurements, Measurement of attenuation, frequency, VSWR (low, medium, high), Measurement of ‘Q’ of a cavity, Impedance measurements.

Learning Outcomes: At the end of this unit, students should be able to

- Understand principle of operation of microwave semiconductors. (L1)
- Differentiate Linear beam tubes and Crossfield Tubes in terms of operation and performance. (L5)

TEXTBOOKS:

1. “Antennas and Wave propagation”, John D. Kraus, Ronald J. Marhefka and Ahmad S. Khan, TMH, New Delhi, 4th Edition, 2010.
2. “Microwave devices and circuits”, Samuel Y. Liao, Pearson Publishing, 3rd Edition, 2003.

REFERENCE BOOKS:

1. “Foundations for microwave engineering”, R. E. Collin, John Wiley, 2nd Edition, 2002.
2. “Antenna Theory- Analysis and Design”, C.A. Balanis, John Wiley & Sons, 2nd Edition, 2001.
3. “Microwave and Radar Engineering”, M. Kulkarni, Umesh Publications, 4th Edition, 2009.
4. “Antenna and Wave Propagation”, G.S.N Raju, Pearson Education India, 3rd Edition 2009.

Course Code	MICROPROCESSORS AND MICROCONTROLLERS		L	T	P	C
21A040421			**3**	**0**	**0**	**3**
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- To introduce fundamental architectural concepts of microprocessors and microcontrollers.
- To impart knowledge on addressing modes and instruction set of 8086 and 8051
- To introduce assembly language programming concepts
- To explain memory and I/O interfacing with 8086 and 8051
- To introduce 16-bit and 32-bit microcontrollers.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand the Architecture of 8086 microprocessor **(K2)**
CO2: Develop 8086 Assembly language programs **(K3)**
CO3: Explain interfacing of 8086 with peripheral devices **(K3)**
CO4: Develop assembly language programs for 8051 Microcontroller **(K3)**
CO5: Illustrate interfacing of 8051 with peripheral devices **(K4)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

8086 Architecture: Evolution of Microprocessors, Main features of 8086, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing unit, execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

Learning Outcomes: At the end of this unit, students should be able to

- Summarize features of a microprocessor (L2)
- Understand the concepts of architecture of 8086. (L2)
- Explain about ISR and interrupt structure of 8086 (L2)
- Compare the minimum and maximum mode configurations of 8086 (L2)

UNIT – II (8 Hrs)

8086 Programming: Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

Learning Outcomes: At the end of this unit, students should be able to

- Understand instruction set of 8086 microprocessor (L2)
- Explain addressing modes of 8086 (L2)
- Develop assembly language programs for various problems (L3)

UNIT – III (10 Hrs)

8086 Interfacing: Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

Learning Outcomes: At the end of this unit, students should be able to

- Explain memory & I/O interfacing with 8086 (L3)
- Describe interfacing of 8086 with peripheral devices (L2)

UNIT – IV (9 Hrs)

8051 Microcontroller and Programming: Comparison of Microprocessor and Microcontroller, Main features of 8051, Architecture of 8051, 8051 pin diagram, Special Function Registers (SFRs), I/O Pins Ports and Circuits, Instruction set, Addressing modes, Assembly language programming.

Learning Outcomes: At the end of this unit, students should be able to

- Describe architecture and features of Intel 8051 microcontroller (L2)
- Develop assembly language programs to perform various operations using 8051 (L3)
- Distinguish between microprocessor and a microcontroller (L2)

UNIT – V (9 Hrs)

Interfacing Microcontroller: Programming 8051 Timers, Serial Port Programming, Interrupts Programming, LCD & Keyboard Interfacing, ADC, DAC & Sensor Interfacing, External Memory Interface, Stepper Motor and Waveform generation.

Advanced Microcontrollers: PIC and ARM processors.

Learning Outcomes: At the end of this unit, students should be able to

- Explain memory & I/O interfacing with 8051 (L3)
- Illustrate interfacing of 8051 with peripheral devices (L4)
- Understand the advancements in the processors (L2)

TEXTBOOKS:

1. "Microprocessors and Interfacing – Programming and Hardware", Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rd Edition, 1994.
2. "Advanced Microprocessors and Peripherals", K M Bhurchandi, A K Ray, McGraw Hill Education, 3rd Edition, 2017.
3. "Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, Pearson, 2nd Edition, 2012.

REFERENCE BOOKS:

1. "Microprocessor 8086 Architecture, Programming, Interfacing", Sunil Mathur, PHI Learning Private Limited, 2011.
2. "The 8051 Microcontroller", Kenneth J. Ayala, Cengage Learning, 3rd Edition, 2004.
3. "Embedded Systems Fundamentals on Arm Cortex-M based Microcontrollers: A Practical Approach", Alexander G. Dean

ONLINE LEARNING RESOURCES:

1. https://www.tutorialspoint.com/microprocessor/microprocessor_overview.htm
2. https://www.geeksforgeeks.org/architecture-of-8086/
3. https://www.javatpoint.com/microcontroller
4. https://computer.howstuffworks.com/microprocessor.htm
5. https://robu.in/8051-microcontroller/

Course Code	DIGITAL SIGNAL PROCESSING		L	T	P	C
21A040422			3	0	0	3
Pre-requisite	Signals and Systems	Semester	VI			

COURSE OBJECTIVES:

- To describe discrete time signals and systems.
- To teach importance of FFT algorithm for computation of Discrete Fourier Transform.
- To expose various implementations of digital filter structures.
- To present FIR and IIR Filter design procedures.
- To outline need of Multi-rate Processing

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Establish difference equations for the discrete time systems. **(K3)**
CO2: Apply FFT algorithms for determining the DFT of a given signal. **(K3)**
CO3: Design IIR digital filter from the given specification. **(K5)**
CO4: Design FIR digital filter from the given specifications. **(K5)**
CO5: Explain the concept of multi-rate DSP and quantization errors **(K3)**

CO-PO MAPPING:

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

UNIT – I (8 Hrs)

Introduction to discrete time signals and systems: Introduction to digital signal processing, review of discrete-time signals and systems, analysis of discrete-time linear time invariant systems, frequency domain representation of discrete time signals and systems, analysis of linear time-invariant systems in the z-domain, pole-zero stability.

Learning Outcomes: At the end of this unit, students should be able to

- Understand different types of signals and systems. (L2)
- Describe discrete time signal. (L2)
- Analyse the linear time-invariant systems by Z transform. (L3)

UNIT – II (9 Hrs)

Discrete Fourier Transform: Introduction, Discrete Fourier Series, properties of DFS, Discrete Fourier Transform, Inverse DFT, properties of DFT, Linear and Circular convolution, convolution using DFT.

Fast Fourier Transforms: Efficient computation of DFT algorithms - Radix 2-Decimation- in-Time & Decimation-in-Frequency algorithms, Inverse FFT, Illustrative problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of DFT and its properties. (L2)
- Determine N-Point DFT/FFT for a given signal/sequence. (L3)

<u>UNIT – III</u> (10 Hrs)

IIR Filters: Introduction to digital filters, Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital filters from analog filters by Impulse invariant and bilinear transformation methods, Frequency transformations ,Basic structures of IIR Filters - Direct form-I, Direct form-II, Cascade form and Parallel form realizations.

Learning Outcomes: At the end of this unit, students should be able to

- Understand signal flow graph and block diagram representations of difference equations to realize different structures for IIR filters. (L2)
- Design of IIR filters using different techniques. (L5)

<u>UNIT – IV</u> (10 Hrs)

FIR Filters: Introduction, Characteristics of FIR filters with linear phase, Frequency response of linear phase FIR filters, Design of FIR filters using Fourier series and windowing methods (Rectangular, Triangular, Hanning, Hamming, Blackman), Comparison of IIR & FIR filters, Basic structures of FIR Filters – Direct form, Cascade form, Linear phase realizations.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of FIR filter and realize different structures for FIR filters (L2)
- Design FIR filter using windowing methods. (L5)

<u>UNIT – V</u> (8 Hrs)

Quantization Errors in Digital Signal Processing: Representation of numbers, Quantization of filter coefficients, Round-off Effects in digital filters.

Multi-rate Digital Signal Processing: Decimation, Interpolation, Sampling rate conversion by a rational factor; Frequency domain characterization of Interpolator and Decimator; Polyphase decomposition.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the types Quantization of errors. (L2)
- Explain the quantization of filter coefficients. (L3)
- Understand the concept of multi-rate Digital Signal Processing. (L2)
- Explain the input and output spectrum of Decimation and Interpolation. (L3)

TEXTBOOKS:

1. "Digital Signal Processing, Principles, Algorithms, and Applications", John G. Proakis, Dimitris G. Manolakis, Pearson Education, 2007.
2. "Discrete Time Signal Processing", A. V. Oppenheim and R.W. Schaffer, PHI.
3. "Digital Signal Processing", Avtar Singh and S. Srinivasan, Thomson Publications, 2004.

REFERENCE BOOKS:

1. "Digital Signal Processing – A practical approach", S.K.Mitra, Pearson Education, 2nd Edition, New Delhi, 2004.
2. "Digital Signal Processing", M H Hayes, Schaum's Outline series, TATA Mc-Graw Hill, 2007.
3. "Fundamentals of Digital Signal Processing using MATLAB", Robert J. Schilling, Sandra L. Harris, Thomson, 2007.
4. "Digital Signal Processors, Architecture, Programming and Applications", B. Venkata Ramani and M. Bhaskar, TMH, 2004.

ONLINE LEARNING RESOURCES:

1. https://www.tutorialspoint.com/digital_signal_processing/index.htm
2. https://nptel.ac.in/courses/117102060
3. https://nptel.ac.in/courses/108106151
4. https://ccrma.stanford.edu/~jos/mdft/mdft.html

Course Code	OPTICAL COMMUNICATIONS		L	T	P	C
21A040423			3	0	0	3
Pre-requisite	Analog Communications, Digital Communications	Semester	VI			

COURSE OBJECTIVES:

- To understand the construction and characteristics of optical fibre cable.
- To develop the knowledge of different losses that occur in optical fibre.
- To develop the knowledge of optical signal sources.
- To identify and understand the operation of various optical detectors.
- To understand the design of optical systems and WDM.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Analyze the constructional parameters of optical fibre **(K4)**
CO2: Estimate the losses due to attenuation, absorption, scattering and bending. **(K4)**
CO3: Analyse the operation of optical signal sources. **(K4)**
CO4: Compare various optical detectors. **(K4)**
CO5: Explain the design of optical systems and WDM. **(K3)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Overview of Optical Fiber Communication: - Historical development, The general system, Advantages of Optical Fiber Communications, Optical Fiber Wave Guides- Introduction, Ray Theory Transmission, Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays, Cylindrical Fibers- Modes, V number, Mode Coupling, Step Index Fibers, Graded Index Fibers. Single Mode Fibers- Cut Off Wavelength, Mode Field Diameter, Effective Refractive Index.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts of Optical fibre Communications & Ray theory transmission. (L2)
- Apply the concepts to solve problems on AA, NA, V number (L3)
- Analyse Single Mode fibre parameters (L4)

UNIT – II (8 Hrs)

Signal Distortion in Optical Fibers: Attenuation, Absorption, Scattering and Bending Losses, Core and Cladding Losses, Transmission Efficiency, Information Capacity Determination, Group Delay, Types of Dispersion - Material Dispersion, Wave-Guide Dispersion, Polarization Mode Dispersion, Intermodal Dispersion, Pulse Broadening, Optimization of Single Mode Fibers.

Learning Outcomes: At the end of this unit, students should be able to

- Understand different types of losses that occur in Optical Fibers (L2)
- Analyse various Dispersion losses that occur in Optical Fibres. (L4)
- Understand how to make use of SMF's for long distance communication by optimization techniques. (L2)

UNIT – III (10 Hrs)

Fiber Splicing & Optical Sources: Splicing Techniques, Splicing Single Mode Fibers, Fiber Alignment and Joint Loss- Multimode Fiber Joints, Single Mode Fiber Joints. Optical Sources- LEDs, Structures, Materials, Quantum Efficiency, Power, Modulation, Power Bandwidth Product, Laser Diodes- Modes, Threshold Conditions, External Quantum Efficiency, Laser Diode Rate Equations, Resonant Frequencies

Learning Outcomes: At the end of this unit, students should be able to

- Understand different types of splicing techniques to join Optical Fibers (L2)
- Understand the construction & working principle of Optical light sources (L2)
- Analyse the operation of optical signal sources. (L4)

UNIT – IV (10 Hrs)

Optical Detectors & Optical Receiver: Physical Principles of PIN and APD, Detector Response Time, Temperature Effect on Avalanche Gain, Comparison of Photo Detectors, Optical Receiver Operation- Fundamental Receiver Operation, Pre-amplifiers, Digital Signal Transmission, Error Sources, Receiver Configuration, Digital Receiver Performance, Probability of Error, Quantum Limit.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the operating principle of photo detector. (L2)
- Estimate the Probability of Error of Optical Receiver. (L4)
- Compare the Performance of different Pre-amplifiers. (L4)

UNIT – V (7 Hrs)

Optical System Design & WDM: Considerations, Component Choice, Point-to- Point Links, Digital Optical Fiber link System Considerations, Link Power Budget, Rise Time Budget, Power penalties, WDM, Necessity, Principles, Types of WDM.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts Design considerations. (L2)
- Understand the concepts of WDM (L2)
- Explain Link Power budget & Rise time budget for Digital Optical Fiber link. (L3)
- Design a Digital Optical Fibre link. (L3)

TEXTBOOKS:

1. "Optical Fiber Communications", Gerd Keiser, Mc Graw Hill Education, 4th Edition, 2008.
2. "Optical Fiber Communications", John M. Senior, Pearson Education, 3rd Edition, 2009.

REFERENCE BOOKS:

1. "Fiber Optic Communications", D.K. Mynbaev, S. C. Gupta and Lowell L. Scheiner, Pearson Education, 2005.
2. "Optical Fibre Communication and its Applications", S. C. Gupta, PHI, 2005.

ONLINE RESOURCE LINKS:

1. https://nptel.ac.in/courses/108106167
2. https://www.tutorialspoint.com/Fiber-Optic-Communications

Course Code	SMART SENSORS		L	T	P	C
21A040424			3	0	0	3
Pre-requisite	Electronic measurement and Instrumentation	Semester	VI			

COURSE OBJECTIVES:

- To understand measuring parameters, measuring systems and characteristics and parameters to be considered for designing an instrument
- Understand different types of sensors/transducers, working principles, selection procedure, applications of sensing systems.
- Select a sensor/sensing system for a requirement.
- Derive sensor-based solution for different applications.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Describe measuring parameters measuring systems, effects of environment, characteristics and parameters to be considered for designing an instrument. **(K3)**

CO2: Choose different types of temperature, humidity, moisture, pressure and force sensors for different applications and explain their working principles. **(K3)**

CO3: Select different types of Occupancy, motion detectors, velocity and acceleration sensors for different applications and explain their working principles. **(K3)**

CO4: Choose different types of flow, acoustic, light and radiation, chemical sensors for different applications and explain their working principles. **(K3)**

CO5: Analyze different sensor network architectures for wireless applications. **(K4)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Introduction to Measurement: Measurement units, applications, elements, choosing appropriate measuring instruments. Instrument Types and Performance Characteristics: Review of instrument types, Static characteristics, dynamic characteristics Error during measurement process: Sources of systematic error, reduction and quantification of systematic errors, random errors, aggregation of measurement system errors. Calibration: Calibration of measuring instruments, Primary calibration, secondary calibration and field calibration. Calibration methods for different parameters (temperature, pressure, humidity, flow...etc.). Automatic Calibration mechanisms.

Learning Outcomes: At the end of this unit, students should be able to

- Understand different measurement parameters. (L2)
- Explain the static and dynamic characteristics of instruments. (L2)
- Develop the knowledge of calibrating a measuring instrument. (L3)

UNIT – II (9 Hrs)

Temperature Sensors: Thermo-resistive, Resistance Temperature Detectors, Silicon Resistive, Thermistors, Semiconductor, Optical, Acoustic, Piezoelectric
Humidity and Moisture Sensors: Capacitive, Electrical Conductivity, Thermal Conductivity, Optical Hygrometer, Time Domain Reflect meter.
Pressure and Force Sensors: Mercury Pressure, Bellows, Membranes, and Thin Plates, Piezoresistive, Capacitive, Optoelectronic, Vacuum, Strain Gauges, Tactile, Piezoelectric Force.
Learning Outcomes: At the end of this unit, students should be able to

- Understand the operating principles of temperature, humidity, moisture, pressure and force sensors. (L2)
- Choose various sensors for measuring temperature, humidity, moisture, pressure and force sensors in different environments. (L3)
- Compare different types of temperature, humidity, moisture, pressure and force sensors. (L2)

UNIT – III (9 Hrs)

Occupancy and Motion Detectors: Ultrasonic, Microwave Motion, Capacitive Occupancy, Visible and Near-Infrared Light, Far-Infrared Motion, PIR Motion, Position, Displacement, and Level Sensors: Potentiometric, Gravitational, Capacitive, Inductive and Magnetic, Optical, Ultrasonic, Radar Velocity and Acceleration Sensors: Capacitive Accelerometers, Piezoresistive Accelerometers, Piezoelectric Accelerometers, Thermal Accelerometers, Heated-Plate Accelerometer, Heated Gas Accelerometer, Gyroscopes, Piezoelectric Cables
Learning Outcomes: At the end of this unit, students should be able to

- Understand the operating principles of occupancy & motion detectors, velocity and acceleration sensors. (L2)
- Select various sensors for measuring occupancy & motion detectors, velocity and acceleration sensors in different environments. (L3)
- Compare different types of occupancy & motion detectors, velocity and acceleration sensors. (L2)

UNIT – IV (8 Hrs)

Flow Sensors: Pressure Gradient Technique, Thermal Transport, Ultrasonic, Electromagnetic, and Micro flow, Coriolis Mass Flow, Acoustic Sensors: Resistive Microphones, Fiber-Optic,

Piezoelectric, Solid-State microphone, Light & Radiation Sensors: Photodiodes, Phototransistor, Photo resistors, Thermal detectors
Chemical Sensors: Metal-Oxide Chemical, ChemFET, Electro-chemical, Potentiometric, Conduct metric, Amperometric, Optical Chemical, Mass Detector

Learning Outcomes: At the end of this unit, students should be able to

- Understand the operating principles of flow, acoustic, light & radiation and chemical sensors. (L2)
- Choose various sensors for measuring flow, acoustic, light & radiation and chemical sensors in different environments. (L3)
- Compare different types of flow, acoustic, light & radiation and chemical sensors. (L2)

UNIT – V (9 Hrs)

Introduction to wireless sensor networks, Challenges for wireless sensor networks, Applications for wireless sensor networks, enabling technologies for wireless sensor networks.
Single node architecture – Hardware components, Energy consumption of Sensor nodes (only Operation states with different power consumption, Relationship between computation and communication, Power consumption of sensor and actuators is included), Deployment environments
Sensor Network Architecture - Sensor Network Scenarios, Optimization goals and figures of merit, Design principles of WSN, Service interfaces of WSNs, Gateway-concepts.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the operating principles of wireless sensor networks. (L2)
- Identify different parameters to evaluate wireless sensor networks. (L2)

TEXTBOOKS:

1. "Measurement and Instrumentation Principles", Alan S Morris, Butterworth-Heinemann Imprint, 3rd Edition, 2001
2. "An Introduction to Error Analysis", John R Taylor, 2nd Edition, 1997
3. "Sensor Technology Handbook", John S Wilson, Elsevier Science, 2004
4. "Protocols and Architectures for Wireless Sensor Networks", Holger Karl & Andreas Willig, John-Wiley, 1st Edition, 2014.

REFERENCE BOOKS:

1. "Mechanical Measurements", Beckwith, Marangoni, Lienhard, Pearson Education India, 6th Edition, 2013
2. "Measurement of Systems - Application and design", Earnest O. Doeblin, McGraw Hill Higher Education, 5th Edition, 2008
3. "Electronic Instrumentation and Measurement Techniques", Albert D Helfrick, Prentice Hall, 3rd Edition, 1985

4. "Wireless Sensor Networks- Technology, Protocols, And Applications", Kazem Sohraby, Daniel Minoli, & Taieb Znati, John Wiley, 2007.

Course Code	VLSI DESIGN		L	T	P	C
21A040425			3	0	0	3
Pre-requisite	Electronic Devices and Circuits, Digital System Design	Semester	VI			

COURSE OBJECTIVES:

- Learn and Understand IC Fabrication process steps required for various MOS circuits.
- Understand and Experience VLSI Design Flow.
- Learn Transistor-Level CMOS Logic Design.
- Understand VLSI Fabrication and Experience CMOS Physical Design.
- Learn to Analyze Gate Function and Timing Characteristics.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain about IC fabrication and relation between different parameters of MOSFET showing its characteristics. **(K3)**

CO2: Estimate sheet resistance, area capacitance, delays in CMOS circuits and develop layouts, stick diagrams of logic circuits using Lambda based rules. **(K4)**

CO3: Design MOSFET based logic circuits using various logic styles like static and dynamic CMOS. **(K5)**

CO4: Analyze the various test generation methods for static and dynamic CMOS circuits. **(K4)**

CO5: Analyze the behaviour of amplifier circuits with various loads. **(K4)**.

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction and Basic Electrical Properties of MOS Circuits: VLSI Design Flow, Introduction to IC technology, Fabrication process: nMOS, pMOS and CMOS. Ids versus Vds relationships, Aspects of MOS transistor: Threshold Voltage, Trans Conductance, Output Conductance and Figure of Merit. nMOS Inverter, Pull-up to Pull-down Ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass transistors. Alternative forms of pull-ups, The CMOS Inverter, Latch-up in CMOS circuits, Bi-CMOS Inverter, Comparison between CMOS and BiCMOS technology.

Learning Outcomes: At the end of this unit, students should be able to

- Understand fabrication process flow. (L2)
- Explain different MOSFET Inverters. (L3)

UNIT – II (9 Hrs)

Basic Circuit Concepts: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, Some area Capacitance Calculations, The Delay Unit, Inverter Delays, Propagation Delays, Wiring Capacitances, Switch logic, Gate logic, Choice of layers, Stick Diagrams, Design Rules and Layout Diagrams for MOS circuits.

Scaling of MOS Circuits: Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling, Limits due to sub threshold currents, Limits on logic levels and supply voltage due to noise and current density.

Learning Outcomes: At the end of this unit, students should be able to

- Apply basic circuit concepts to MOS circuits. (L3)
- Apply the design Rules and draw layout of a given logic circuit (L3).
- Estimate the sheet resistance, square capacitance and propagation delays in CMOS circuits (L4)

UNIT – III (9 Hrs)

CMOS Combinational and sequential logic circuit design:

Static CMOS Design: Complementary CMOS, Ratioed Logic, Pass-Transistor Logic.

Dynamic CMOS Design: Dynamic Logic-Basic Principles, Speed and Power Dissipation of Dynamic Logic, Issues in Dynamic Design, Cascading Dynamic Gates, Choosing a Logic Style, Timing Metrics for Sequential Circuits, Latches Vs Register, The Bistability Principle, SR Flip-Flops, Multiplexer-Based Latches, Master-Slave Edge-Triggered Register, Reduced load clock load static master-slave register, C2MOS—A Clock-Skew Insensitive approach Pipelining.

Learning Outcomes: At the end of this unit, students should be able to

- Analyze the behaviour of static and dynamic logic circuits. (L4)
- Design MOSFET based logic circuits using various logic styles like static and dynamic CMOS. (L5)

UNIT – IV (9 Hrs)

Fault Modeling & Testing : Fault classes and models–Stuck at faults, bridging faults, transition and intermittent faults. Design for Testability, Testing Combinational Logic-Path Sensitization technique, Boolean difference method, Testing Sequential Logic, Practical Design for Test (OFT) Guidelines, Scan Design Techniques, Built-In-Self-Test (BIST).

Learning Outcomes: At the end of this unit, students should be able to

- Identify the design for testability methods for combinational & sequential CMOS circuits. (L2)
- Analyze the various test generation methods for static and dynamic CMOS circuits. (L4)

UNIT – V (9 Hrs)

Basic building blocks of Analog IC design: Regions of operation of MOSFET, Modelling of transistor, body bias effect, biasing styles, single stage amplifier with resistive load, single stage amplifier with diode connected load, Common Source amplifier, Common Drain amplifier, Common Gate amplifier.

Learning Outcomes: At the end of this unit, students should be able to

- Analyze the behaviour of amplifier circuits with various loads. (L4)
- Design amplifier circuits using MOS transistors. (L3)

TEXTBOOKS:

1. "Essentials of VLSI Circuits and Systems", Kamran Eshraghian, Douglas A. Pucknell and Sholeh Eshraghian, Prentice Hall of India Private Limited, 2005.
2. "Design of Analog CMOS Integrated Circuits", Behzad Razavi , McGraw Hill, 2003
3. "Digital Integrated Circuits", Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, Prentice-Hall of India Private Limited, 2nd Edition, 2009.

REFERENCE BOOKS:

1. "Introduction to VLSI Circuits and Systems", John P. Uyemura, John Wiley & Sons, reprint 2009.
2. "Logic Design Theory", N.N. Biswas, Prentice Hall of India, 1st Edition, 2002

Course Code	ANTENNAS & MICROWAVE ENGINEERING LAB		L	T	P	C
21A040426			0	0	3	1.5
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:
- To understand the working, different microwave components and verify characteristics using microwave bench setup.
- To study characteristics and radiative patterns of various antennas

COURSE OUTCOMES:
After completion of the course, the student will be able to

CO1: Understand the working of different microwave components and sources in a microwave bench. **(K2)**
CO2: Compare the characteristics of various microwave components using microwave bench setup. **(K4)**
CO3: Simulate various antennas. **(K3)**
CO4: Analyse performance characteristics of Antennas **(K4)**

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

Part-A: ANTENNAS LAB

1. Analyze the characteristics of Simple Dipole λ/2 and λ/4 Antenna
2. Analyze the variation in the Radiation Strength at given distance from Antenna
3. Analyze the Reciprocity Theorem for Antennas
4. Simulate Folded Dipole λ /2 Antenna
5. Simulate Yagi Uda 3 element Folded Dipole, 5 element folded dipole.
6. Analyze the characteristics and radiation pattern of broad side and end fire arrays.
7. Analyze the characteristics of micro strip antennas.

Part-B: MICROWAVE ENGINEERING LAB

1. Reflex Klystron Characteristics.
2. Gunn Diode Characteristics.
3. Directional Coupler Characteristics.
4. VSWR Measurement.
5. Measurement of Scattering Parameters of a Magic Tee.
6. Measurement of Scattering Parameters of a Circulator.
7. Attenuation Measurement.
8. Microwave Frequency Measurement.

SOFTWARE REQUIRED:

1. ADS / HFSS / CST or any equivalent simulation software

NOTE: At least 6 Experiments from each section shall be performed

Course Code	MICROPROCESSORS AND MICOCONTROLLERS LAB		L	T	P	C
21A040427			0	0	3	1.5
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- To acquire the knowledge on microprocessors and microcontrollers
- To interfacing various peripherals
- To Learn Assembly/Embedded C programming approach for solving real world problems
- To configure and develop programs to interface peripherals/sensors

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Examine problems and implement algorithms using Assembly language. **(K4)**
CO2: Develop programs for different applications. **(K3)**
CO3: Connect peripheral devices with 8086. **(K4)**
CO4: Connect peripheral devices with 8051. **(K4)**

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. PROGRAMS FOR 16 BIT ARITHMETIC OPERATIONS (Using various addressing modes)
   a) Write an ALP to Perform Addition and Subtraction of Multi precision numbers.
   b) Write an ALP to Perform Multiplication and division of signed and unsigned Hexadecimal numbers.
   c) Write an ALP to find square, cube and factorial of a given number.
2. PROGRAMS INVOLVING BIT MANIPULATION INSTRUCTIONS
   a) Write an ALP to find the given data is positive or negative.
   b) Write an ALP to find the given data is odd or even.
   c) Write an ALP to find Logical ones and zeros in a given data.
3. PROGRAMS ON ARRAYS FOR 8086
   a) Write an ALP to find Addition/subtraction of N numbers.
   b) Write an ALP for finding largest/smallest number.
   c) Write an ALP to sort given array in Ascending/descending order.
4. PROGRAM FOR STRING MANIPULATIONS FOR 8086
   a) Write an ALP for Displaying the given String.
   b) Write an ALP to find String length.
   c) Write an ALP for Comparing two Strings.

   d) Write an ALP to reverse String.
5. PROGRAM FOR DIGITAL CLOCK DESIGN USING 8086
   a) Write an ALP for Designing clock using INT 21H Interrupt.
   b) Write an ALP for Designing clock by reading system time.
6. INTERFACING STEPPER MOTOR WITH 8086
   a) Write an ALP to 8086 processor to Interface a stepper motor and operate it in clockwise by choosing variable step-size.
   b) Write an ALP to 8086 processor to Interface a stepper motor and operate it in Anti-clockwise by choosing variable step-size.
7. INTERFACING ADC/DAC WITH 8086
   a) Write an ALP to 8086 processor to Interface ADC.
   b) Write an ALP to 8086 processor to Interface DAC and generate Square Wave/Triangular Wave/Staircase Wave.
8. COMMUNICATION BETWEEN TWO MICROPROCESSORS
   a) Write an ALP to have Parallel communication between two microprocessors using 8255
   b) Write an ALP to have Serial communication between two microprocessor kits using 8251
9. PROGRAMS USING ARITHMETIC AND LOGICAL INSTRUCTIONS FOR 8051
   a) Write an ALP to 8051 Microcontroller to perform Arithmetic operations like Addition, Subtraction, Multiplication and Division.
   b) Write an ALP to 8051 Microcontroller to perform Logical operations like AND, OR and XOR.
10. PROGRAM TO VERIFY TIMERS OF 8051
    a) Write a program to create a delay of 25msec using Timer0 in mode 1 and blink all the Pins of P0.
    b) Write a program to create a delay of 50 µsec using Timer1 in mode 0 and blink all the Pins of P2.
11. UART OPERATION IN 8051
    a) Write a program to transfer a character serially with a baud rate of 9600 using UART.
    b) Write a program to transfer a character serially with a baud rate of 4800 using UART.
12. INTERFACING LCD WITH 8051
    Develop and execute the program to interface16*2 LCD to 8051.

REFERENCE BOOKS:

1. "The 8051 microcontroller", Kenneth. J. Ayala, Cengage learning, 3rd Edition, 2010.
2. "Advanced microprocessors and peripherals", A. K. Ray and K. M. Bhurchandani, TMH, 2nd Edition, 2006.
3. "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Muhammad Ali Mazidi, Janice Gillispie Mazidi, 2nd Edition.

Note: Any TEN of the above experiments shall be performed.

Course Code	DIGITAL SIGNAL PROCESSING LAB		L	T	P	C
21A040428			0	0	3	1.5
Pre-requisite	Signals and Systems	Semester	VI			

COURSE OBJECTIVES:

- To familiarize students with practical implementation of the digital signal processing.
- To apply knowledge of mathematics, science and engineering**:** Construction of tools for visualizing the basic concepts of discrete signal representation such as Fourier transforms, discrete time representations.
- To learn numerous programming tools for design and of filtering implementations algorithms.
- To understand the concept of multi-rate signal processing and sample rate conversion.
- To develop and implement DSP algorithms in software using CCS with DSP floating point processor

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Implement various DSP Algorithms using MATLAB / Code Composer Studio (CCS). (**K3**)

CO2: Analyze and observe magnitude and phase characteristics (Frequency response characteristics) of digital IIR-Butterworth, Chebyshev filters. (**K4**)

CO3: Analyze and observe magnitude and phase characteristics (Frequency response characteristics) of digital FIR filters using window techniques. (**K4**)

CO4: Design and Analyze Digital Filters using FDA Tool. (**K5**)

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. Generate the following standard discrete time signals.
   i) Unit Impulse ii) Unit step iii) Ramp iv) Exponential v) Sawtooth
2. Generate the sum of two sinusoidal signals and find the frequency response (magnitude and phase).
3. Find frequency response of a system given in transfer function/ differential equation form.
4. Implement and verify linear and circular convolution between two given signals.

5. Compute and implement the N-point DFT of a given sequence and compute the power density spectrum of the sequence.
6. Implement and verify N-point DIT-FFT & IFFT of a given sequence and find the frequency response (magnitude and phase).
7. Design IIR Butterworth filter and compare their performances with different orders (Low Pass Filter /High Pass Filter)
8. Design IIR Chebyshev filter and compare their performances with different orders (Low Pass Filter /High Pass Filter)
9. Design FIR filter (Low Pass Filter /High Pass Filter) using windowing technique.
    i. Using rectangular window
    ii. Using hamming window
    iii. Using Kaiser window
10. Design and verify IIR/ FIR Filter frequency response by using Filter design and Analysis (FDA) Tool.
11. Compute the Decimation and Interpolation for the given signal.
12. Study the architecture of DSP chips – TMS 320C 5X/6X Instructions.
13. Find DFT / IDFT of given discrete time signal.
14. Design and implementation of IIR Butterworth / Chebyshev (LP/HP) filter.
15. Design and implementation of FIR with low pass / high pass filter using any windowing technique. Plot its magnitude and phase response.

Note:

1. The experiments 1 to 12 shall be conducted using MATLAB / Lab View / C Programming/ Equivalent software & experiments 13 to 15 shall be conducted using TI / Analog Devices / Motorola / Equivalent DSP processors.
2. Any twelve of the above experiments shall be performed.

REFERENCE BOOKS:

1. “Discrete Time Signal Processing”, A. V. Oppenheim and R.W. Schaffer, PHI.
2. “Digital Signal processing”, S.K. Mitra, TMH, 2nd Edition

ONLINE LEARNING RESOURCES:

1. http://vlabs.iitkgp.ac.in/dsp/#

Course Code	RF SYSTEM DESIGN		L	T	P	C
21A010703			1	0	2	2
Pre-requisite	Electronic Circuit Analysis and Design, Antennas and Microwave Engineering	Semester	VI			

COURSE OBJECTIVES:

- Verify the basic principles and design aspects involved in high frequency communication systems components.
- Conduct the experiments on different high frequency components to analyze and interpret data to produce meaningful conclusion and match with theoretical concepts.
- Design and develop RF components using microstrip technology.
- Apply knowledge of basic RF Electronics for realizing any RF system.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Design various RF passive and active components and analyze their performance. **(K5)**

CO2: Design and Evaluate the performance of RF circuits S-parameters, Signal flow graphs and smith charts. **(K5)**

CO3: Analyze the performance of RF Microstrip antennas. **(K4)**

CO4: Design and Analyze Microstrip Transmission Line standing wave pattern at various frequencies. **(K4)**

CO-PO MAPPING:

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

UNIT – I

Basic Concepts in RF Design: Introduce any RF design software and orient students with the tools of the laboratory. Practice the tool to use it for significant design. Introduction to RF Design, Time Variance and Nonlinearity, Effects of nonlinearity, Passive impedance transformation, Scattering parameters, impedance matching, L match, Pi match, T match, Passive IC Components-Resistors, Capacitors Inductors, Schottky Diode, RF Switch.

UNIT – II

RF Power Amplifiers and Filters: RF Power amplifier design examples, Gain equalizers, Voltage controlled oscillators, Phase Locked Loops, Linearized PLL models, High frequency oscillators, LPF, HPF and BPF.

UNIT – III

LNA, VCO and Mixers: General considerations, Problem of input matching, Low Noise Amplifiers design in various topologies, Gain Switching, Band Switching, Voltage Controlled Oscillators, Mixers-General considerations.

UNIT – IV

Microstrip transmission lines and discontinuities: S parameters of a Microstrip Transmission Line, Smith Chart, Analysis of Microstrip Transmission Line standing wave patterns at various frequencies, Different types of Transmission lines like CPW, Microstrip and Co-axial cable. Different types of Microstrip discontinuities like Bend, T, Via, Gap etc., Microstrip Ring Resonator.

LIST OF EXPERIMENTS:

1. Design of $\lambda/2$, $\lambda/4$ Microstrip Transmission line.
2. Design of Microstrip Inductor and Capacitor.
3. Design of Impedance matching network.
4. Design and Simulate a Schottky Diode and RF Switch.
5. Design and characterization of RF BJT Amplifier and LNA.
6. Analyse and measure the gain of a Power Amplifier and equalise its gain using an Equalizer.
7. Design of Low pass, High pass, Band pass and Band stop filter at RF.
8. Design and characterization of RF Mixer.
9. Design and characterization of VCO.
10. Measure the S parameters of a Microstrip Transmission Line and plot the normalised impedance on a Smith chart.
11. Analysis of Microstrip Transmission Line standing wave pattern at various frequencies.
12. Study of different types of Transmission lines like CPW, Microstrip and Co-axial and find/measure its Insertion Loss (S21 and S12).
13. Study of different types of Microstrip discontinuities like Bend, T, Via, Gap etc and find/measure its Insertion loss.
14. Design and characterization of Microstrip Patch Antennas.
15. Determine the Bandwidth and Quality Factor of a Microstrip Ring Resonator.

SOFTWARE REQUIRED:

1. ADS/IE3D/HFSS or any similar/ equivalent tool

Note: Minimum Twelve experiments shall be performed.

REFERENCE BOOKS:

1. “Design of CMOS RF Integrated Circuits”, T. Lee, Cambridge, 2004.
2. “RF circuit design”, Reinhold Ludwig and Pavel Bretchko, Pearson Education, 2007.
3. “RF Microelectronics”, B. Razavi, Pearson Education, 2012.

Course Code	RESEARCH METHODOLOGY (Common to all branches)		L	T	P	C
21A000004			2	0	0	0
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- To understand the basic concepts of research and research problem
- To make the students learn about various types of data collection and sampling design
- To enable them to know the method of statistical evaluation
- To make the students understand various testing tools in research
- To make the student learn how to write a research report
- To create awareness on ethical issues n research

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Know how to define a Research problem, select suitable design and experimental approach. **(K1)**
CO2: Formulate sampling design and various techniques implemented on data collection. **(K6)**
CO3: Correlate any two variables and find the solution using regression analysis. **(K4)**
CO4: Examine hypothesis testing procedure, Analyze the significance of variance and covariance. **(K4)**
CO5: Write a report on research work for seminars, conferences formats. **(K6)**

CO-PO MAPPING:

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

UNIT – I (6 Hrs)

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – Research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of research and its process. (L2)
- Explain various types of research. (L2)
- Explain the steps involved in research design. (L2)
- Understand the different research approaches. (L2)

UNIT – II (6 Hrs)

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design. Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation. Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of sampling and sampling design. (L2)
- Explain various techniques in measurement and scaling. (L2)
- Understand various methods of data collection. (L2)
- Design survey questionnaires for different kinds of research. (L3)
- Analyze the questionnaires. (L4)

UNIT – III (6 Hrs)

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

Learning Outcomes: At the end of this unit, students should be able to

- Understand the importance of correlation and regression. (L2)
- Compare and contrast correlation and regression. (L3)
- Explain various types of correlation. (L3)
- Apply the knowledge of C&R Analysis to get the results. (L3)

UNIT – IV (6 Hrs)

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multivariate Analysis

Learning Outcomes: At the end of this unit, students should be able to

- Understand the hypothesis testing procedure. (L2)
- Compare and contrast Parametric and Non-parametric Tests. (L3)
- Understand the use of chi-square test in investigating the distribution of categorical variables. (L2)
- Analyze the significance of variance and covariance. (L4)

UNIT – V (6 Hrs)

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

Learning Outcomes: At the end of this unit, students should be able to

- Understand how to write a report and research paper. (L2)
- Explain various techniques of interpretation. (L2)
- Understand the importance of professional ethics in research. (L2)

- Design a scientific paper to present in the conferences/seminars. (L3)

TEXTBOOKS:

1. "Research Methodology: Methods and Techniques", C.R.Kothari, New Age International Publishers, 2nd Edition,.
2. "Research Methodology: A Step-by-Step Guide for Beginners", Ranjit Kumar, Sage Publications

REFERENCE BOOKS:

1. "Research Methodology and Statistical Tools", P. Narayana Reddy and G. V. R. K. Acharyulu, Excel Books, New Delhi, 1st Edition.
2. "Business Research Methods", Donald R. Cooper & Pamela S Schindler, 9th Edition.
3. "Fundamentals of Statistics", S C Gupta, Himalaya Publications, 7th Edition

Course Code	EMBEDDED SYSTEM DESIGN		L	T	P	C
21A040429			3	0	0	3
Pre-requisite	Microprocessors and Microcontrollers	Semester	VII			

COURSE OBJECTIVES:

- To understand the basics of an embedded system and RTOS
- To introduce the typical components of an embedded system
- To explain interfacing of various communication and I/O devices to an embedded system
- To provide knowledge on the design process of embedded system applications

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain the basic concepts of an embedded system **(K3)**

CO2: Explain the role of system core, memory, sensors, actuators, I/O and other subsystem components in an embedded system **(K3)**

CO3: Explain the different communication interfaces of an embedded system **(K3)**

CO4: Describe various steps involved in design and development of embedded firmware **(K3)**

CO5: Explain the functions of RTOS **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction to Embedded Systems: History of embedded systems, Classification of embedded systems based on generation and complexity, Purpose of embedded systems, The embedded system design process-requirements, specification, architecture design, designing hardware and software components, system integration, Applications of embedded systems, and characteristics of embedded systems.

Learning Outcomes: At the end of this unit, students should be able to

- Classify embedded systems based on generation, complexity and performance (L2)
- Discuss the characteristics of an embedded system (L2)
- Explain the design process in embedded system (L3)

UNIT – II (9 Hrs)

Typical Embedded System: Core of the embedded system-general purpose and domain specific processors, ASICs, PLDs, COTs; Memory-ROM, RAM, memory according to the type of interface, memory shadowing, memory selection for embedded systems, Sensors, actuators, I/O components: seven segment LED, relay, piezo buzzer, push button switch, other sub-systems: reset circuit, brownout protection circuit, oscillator circuit real time clock, watch dog timer.

Learning Outcomes: At the end of this unit, students should be able to

- Discuss about the core of the embedded system (L2)
- Summarize different factors to be considered in the selection of memory for an embedded system (L2)
- Explain role of sensors, actuators, I/O components and other subsystem components used in embedded system (L3)

UNIT – III (9 Hrs)

Communication Interface: Onboard communication interfaces - I2C, SPI, CAN, parallel interface; External communication interfaces - RS232, USB, infrared, Bluetooth, Wi-Fi, ZigBee, GPRS, GSM

Learning Outcomes: At the end of this unit, students should be able to

- Explain the various types of on-board communication interfaces (L3)
- Describe the external communication interfaces used in embedded system (L2)
- Discuss the different types of wireless communication interfaces used in embedded system (L2)
- Illustrate different Inter Process Communication (IPC) mechanisms used by tasks / process / tasks to communicate in multitasking environment (L4)

UNIT – IV (9 Hrs)

Embedded Firmware Design and Development: Embedded firmware design approaches -super loop based approach, operating system based approach; embedded firmware development languages - assembly language based development, high level language based development.

Learning Outcomes: At the end of this unit, students should be able to

- Discuss the different approaches for embedded firmware design (L2)
- Discuss the different embedded firmware development languages (L2)
- Explain the process of Assembly language to machine language conversion and High-level language to machine language conversion (L3)
- Design simple embedded system based applications (L6)

UNIT – V (9 Hrs)

RTOS Based Embedded System Design: Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling: non-pre-emptive and pre-emptive scheduling; task communication-shared memory, message passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/ Synchronization Issues, Task Synchronization Techniques

Learning Outcomes: At the end of this unit, students should be able to

- Explain about operating system and RTOS (L2)
- Differentiate multiprocessing and multitasking (L3)
- Discuss the various types of task scheduling (L2)
- Describe the task communication and synchronization (L3)
- Build RTOS based Embedded System for various applications (L6)

TEXTBOOKS:

1. "Introduction to Embedded Systems", Shibu K V, McGraw Hill Education, 2nd edition, 2017.
2. "Embedded Systems: Architecture, Programming and Design", Raj Kamal, McGraw Hill Education, 3rd edition, 2017

REFERENCE BOOKS:

1. "Computers as Components", Wayne Wolf, Morgan Kaufmann, Elsevier, 2nd edition
2. "Embedded Systems- An integrated approach", Lyla b das, Pearson education, 2012
3. "Embedded Microcomputer Systems Real Time Interfacing", Jonathan W. Valvano, Cengage Learning, 3rd edition, 2012.

Course Code	DSP PROCESSORS & ARCHITECTURES		L	T	P	C
21A040430			3	0	0	3
Pre-requisite	Digital Signal Processing	Semester	VII			

COURSE OBJECTIVES:

- To describe unique features of Digital signal processing.
- To understand the basics and various computational parameters of DSP devices.
- To understand the architectural improvements, On-chip Peripherals and Instruction set in programmable DSP devices.
- To outline DSP processors for developing various applications.
- To study the Advanced Programmable DSP Processors

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Summarize features of Digital Signal Processing and evaluate dynamic ranges and precision for the given DSP system (**K2**)

CO2: Explain architectural features of DSP processors (**K2**)

CO3: Analyze the performance of various TMS320C5xx DSP devices. (**K4**)

CO4: Analyze performance of various TMS320C6x and ADSP processors. (**K4**)

CO5: Select DSP processors for building real time applications (**K4**)

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction: Signal Processing concepts, the sampling process, Review of Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT), Digital filters, Decimation and interpolation.

Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of Error in DSP Implementation, A/D Conversion Errors, D/A Conversion Errors

Learning Outcomes: At the end of this unit, students should be able to

- Understand the fundamentals of digital signal processing. (L2)
- Understand the source of errors in DSP implementations.(L2)

UNIT – II (8 Hrs)

Architecture for Programmable DSP Devices: Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Programmability and Program Execution, Speed Issues, On chip Peripherals, Commercial Digital Signal Processing Devices,

Learning Outcomes: At the end of this unit, students should be able to

- Understand the fundamentals of programmable digital signal processors. (L2)
- Describe the Architectural Features of programmable DSP processors. (L2)

UNIT – III (10 Hrs)

TMS320C54xx Processor: Features, Internal architecture, Data Addressing Modes, Memory space of TMS320C54xx Processors, TMS320C54xx Instructions and Programs

TMS320C55x Processor: Features, CPU and memory Architecture, Addressing modes and pipeline operations.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the architecture and addressing modes of TMS320C5xx digital signal processors. (L2)
- Analyze the performance of various TMS320C5xx DSP devices.(L4)

UNIT – IV (9 Hrs)

TMS320C6x Processor: Features, Internal architecture, data paths and control register file, Addressing modes and pipeline operation and interrupts

ADSP Processors: Architecture of ADSP-21XX and ADSP-210XX series of DSP processors-Addressing modes

Learning Outcomes: At the end of this unit, students should be able to

- Understand the architecture and addressing modes of TMS320C6xx digital signal processors. (L2)
- Understand the architecture and addressing modes of ADSP Processors. (L2)
- Analyze the performance of various TMS320C6x and ADSP devices.(L4)

UNIT – V (9 Hrs)

Applications of Programmable DSP Devices: A DSP System, DSP Based Biotelemetry Receiver, A Speech Processing System, An Image Processing System.

Learning Outcomes: At the end of this unit, students should be able to

- Develop the algorithm suitable for signal processing applications. (L3)
- Select the suitable processor for the different applications. (L4)

TEXTBOOKS:

1. "Digital Signal Processors, Architecture, Programming and Applications", B. Venkataramani and M. Bhaskar, TMH, 2002.
2. "Digital Signal Processing", Avtar Singh and S. Srinivasan, Thomson Publications, 2004.

REFERENCE BOOKS:

1. "Algorithms for Statistical Signal Processing", J. G. Proakis, Pearson,2002.
2. "A Practical Approach to Digital Signal Processing", K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009
3. "DSP Processor Fundamentals - Architectures & Features", Lapsley et al., S. Chand & Co.,2000
4. User guides Texas Instruments, Analog Devices and NXP.

Course Code	SATELLITE COMMUNICATIONS		L	T	P	C
21A040431			3	0	0	3
Pre-requisite	Analog Communications, Digital Communications	Semester	VII			

COURSE OBJECTIVES:

- To understand the basic concepts, applications, frequencies used and types of satellite communications
- To understand the concept of look angles, launches and launch vehicles, orbital effects in satellite communications.
- To understand the various satellite subsystems and its functionality.
- To understand the concepts of satellite link design and calculation of C/N ratio.
- To understand the concepts of multiple access and various types of multiple access techniques in satellite systems
- To understand the concepts of satellite navigation, architecture and applications of GPS.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand the historical background, orbital mechanics, launch vehicles and functional principles of satellite communication systems. **(K2)**

CO2: Apply reliability techniques for various subsystems of a satellite and study their role in satellite working. **(K3)**

CO3: Analyze a satellite link and suggest enhancements to improve the link performance. **(K4)**

CO4: Interpret the Earth station and tracking of the satellites. **(K5)**

CO5: Evaluate the low orbit geo-stationary satellite requirements and GPS. **(K4)**

CO-PO MAPPING:

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

UNIT – I (8 Hrs)

Introduction: Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications.

Orbital Mechanics and Launchers: Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the working of satellite and their applications. (L2)
- Understand the various orbital mechanics and launch vehicles. (L2)
- Understand the frequency allocations for Satellite communications. (L2)

UNIT – II (9 Hrs)

Satellite Subsystems: Altitude and orbit control system, telemetry, tracking, Command and Monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space Qualification

Learning Outcomes: At the end of this unit, students should be able to

- Understand the roles all the subsystems of a satellite. (L3)
- Explain the modules of satellite sub system and earth stations (L3).
- Apply reliability techniques for the space qualification of equipment. (L3)

UNIT – III (10 Hrs)

Satellite Link Design: Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.

Multiple Access: Frequency division multiple access (FDMA) Inter modulation, Calculation of C/N. Time division Multiple Access (TDMA) Frame structure, Examples. Satellite Switched TDMA Onboard processing, DAMA, Code Division Multiple access (CDMA), Spread spectrum transmission and reception.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various multiple access techniques (L2)
- Apply various multiple access techniques for satellite communications (L2)
- Apply frequency allocation standards, reliability techniques, multiple access techniques (L3)
- Analyze link budget of satellite signal for proper communication (L4)
- Design Uplink and Downlink of a satellite (L4)

UNIT – IV (9 Hrs)

EARTH STATION TECHNOLOGY: Introduction, Transmitters, Receivers, Antennas, Tracking systems, Terrestrial interface, Primary power test methods.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various subsystems of an earth station (L2).
- Apply power test methods to earth stations (L3).
- Choosing different kinds of transmitter and receiver antennas to provide Uplink and Down Link Frequency (L5).

<u>UNIT – V</u> (9 Hrs)

LOW EARTH ORBIT AND GEO-STATIONARY SATELLITE SYSTEMS: Orbit consideration, coverage and frequency considerations, Delay & Throughput considerations, System considerations, Operational NGSO constellation Designs

SATELLITE NAVIGATION & THE GLOBAL POSITIONING SYSTEM: Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers and codes, Satellite signal acquisition, GPS Navigation Message, GPS signal levels, GPS receiver operation, GPS C/A code accuracy, Differential GPS.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts of low earth orbit and geo-stationary satellite systems (L2).
- Demonstrate the impacts of GPS, Navigation, NGSO constellation design for tracking and launching (L2).
- Analyze satellite navigation and global positioning system (L4).

<u>TEXTBOOKS:</u>

1. "Satellite Communications", Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.
2. "Satellite Communications Engineering", Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud, Pearson Publications, 2nd Edition, 2003.
3. "Satellite Communications", Robert M. Gagliardi, CBS Publications, 2nd Edition.

<u>REFERENCE BOOKS:</u>

1. "Satellite Communications: Design Principles", M. Richharia, BS Publications, 2nd Edition, 2003.
2. "Satellite Communication", D.C Agarwal, Khanna Publications, 5th Edition.
3. "Fundamentals of Satellite Communications", K. N. Raja Rao, PHI, 2004
4. "Satellite Communications", Dennis Roddy, McGraw Hill, 2nd Edition, 1996.

<table>
<tr><td>Course Code</td><td rowspan="2" colspan="2">CELLULAR AND MOBILE COMMUNICATIONS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>21A040432</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td>Analog Communications & Digital Communications</td><td>Semester</td><td colspan="4">VII</td></tr>
</table>

COURSE OBJECTIVES:

- To understand the concepts and operation of cellular systems.
- To apply the concepts of cellular systems to solve engineering problems.
- To present impairments due to multipath fading channel, frequency management, Channel assignment and types of handoffs.
- To evaluate suitability of a cellular system in real time applications.
- To design cellular patterns based on frequency reuse factor.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Analyze the characteristics of cellular systems **(K4)**

CO2: Apply the concepts of co-channel interference & Cell splitting to solve engineering problems **(K3)**

CO3: Analyze Co-channel and Non-Co-channel interferences **(K4)**

CO4: Explain frequency management and channel assignment **(K3)**

CO5: Evaluate suitability of a cellular system in real time applications **(K4)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Introduction to Cellular Mobile Radio Systems: Limitations of Conventional Mobile Telephone systems, Basic Cellular Mobile systems, Uniqueness of Mobile Radio Environment, Mobile Fading Characteristics, Operations of Cellular Systems, Evolution of Cellular Systems.

Fundamentals of Cellular Radio System Design: Concept of Frequency Reuse, Co-Channel Interference, Co-Channel Interference Reduction Factor, Desire C/I from a normal case in a Omni Directional Antenna system, System capacity, Trunking and Grade of Service, Improving coverage and capacity in Cellular Systems – Cell Splitting, Sectoring, Mirocell Zone concept.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts and operation of cellular systems (L2).

- Understand the concept of frequency reuse and co-channel interference in cellular systems (L2).
- Analyze the characteristics of mobile radio environment (L4).

UNIT – II (8 Hrs)

Cell Coverage for Signal & Traffic: Signal Reflections in Flat and Hilly Terrain, Effect of Human Made Structures, Phase Difference between Direct & Reflected Paths, Constant Standard Deviations, Straight Line path loss, Slope, General Formula for Mobile Propagation over Water and Flat open area, Near and Long distance propagation, Path loss from a point to point prediction model in Different conditions, Merits of Lee Model.

Cell Site & Mobile Antennas: Space Diversity Antennas, Umbrella Pattern Antennas, Minimum Separation of Cell Site Antennas, Mobile antennas.

Learning Outcomes: At the end of this unit, students should be able to

- Apply the concept of cellular systems & Mobile Antennas to solve engineering problems (L3).

UNIT – III (10 Hrs)

Co-Channel Interference Reduction: Measurement of Real time Co-Channel Interference, Design of Omni directional & Directional Antenna system, Antenna Parameters and Their Effects, Diversity Techniques- Space Diversity, Polarization Diversity, Frequency Diversity, Time Diversity.

Non-Co-Channel Interference: Adjacent Channel interference, Near End & Far End interference, Cross talk, Effects on coverage and interference by Power decrease, Antenna Height Decrease, Effects of Cell Site Components.

Learning Outcomes: At the end of this unit, students should be able to

- Understand Co-Channel & Non Co-Channel interference (L2)
- Analyze concept of Omnidirectional & Directional antenna to solve engineering problems (L4).

UNIT – IV (8 Hrs)

Frequency Management & Channel Assignment: Numbering and Grouping, Setup Access and Paging Channels, Channel Assignments to Cell Site and Mobile Units, Channel Sharing and Borrowing, Overlaid Cells, Non Fixed Channel Assignment.

Learning Outcomes: At the end of this unit, students should be able to

- Understand Numbering & Grouping (L2).
- Make use of concepts of Channel Sharing & Borrowing to solve engineering problems (L3).

UNIT – V (9 Hrs)

Handoffs and Dropped Calls: Handoff initiations, Types of Handoff, Delaying Handoff, Advantages of Handoff, Power difference Handoff, Forced Handoff, Mobile Assisted and Soft Handoffs, Intersystem Handoff, Introduction to Dropped Call Rates and Evaluation.

System Evaluation: Performance Evaluation, Blockage, Dropped-call rate, Signaling Evaluation – False Alarm Rate, Word error rate consideration and calculations, Measurement of average received signal level and level crossings.

Learning Outcomes: At the end of this unit, students should be able to

- Compare various types of handoffs (L3).
- Compare various types of digital cellular systems (L3).
- Evaluate suitability of a cellular system in real time applications (L4).

TEXTBOOKS:

1. "Mobile Cellular Telecommunications", William C. Y. Lee, 2nd Edition, McGraw-Hill International, 1995.
2. "Wireless Communications – Principles and Practice", Theodore S. Rappaport, 2nd Edition, PHI, 2004.

REFERENCE BOOKS:

1. "Mobile Communication Engineering – Theory & Application", W. C. Y. Lee, 2nd Edition, McGraw-HillInternational, 2014.
2. "Principles of Mobile Communications", Gordon L. Stuber, Springer International, 2nd Edition 2001.
3. "Modern Wireless Communications", Simon Haykin, Michael Moher, Pearson Education, 2005

ONLINE LEARNING RESOURCES:

1. https://nptel.ac.in/courses/117102062
2. https://www.electronicshub.org/wireless-communication-introduction-types-applications/
3. https://en.wikipedia.org/wiki/Cellular_network

Course Code	BIOMEDICAL SIGNAL PROCESSING		L	T	P	C
21A040433			3	0	0	3
Pre-requisite	Digital Signal Processing	Semester	VII			

COURSE OBJECTIVES:

- To describe the origin, properties and suitable models of important biological signals
- To introduce students to basic signal processing techniques in analyzing biological signals.
- To develop a thorough understanding on basics of ECG signal compression algorithms.
- To increase awareness of the complexity of various biological phenomena and cultivate an understanding of the promises, challenges of the biomedical engineering.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain the origin and properties of biomedical signals like ECG, EEG, EMG, PCG, EOG signals **(K3)**

CO2: Compare modern filtering and compression techniques required for biomedical signal processing **(K4)**

CO3: Analyze the nature of biomedical signals and related concepts, and event detection techniques for ECG signals **(K4)**

CO4: Analyze the nature of biomedical signals and related concepts, and event detection techniques for EEG and EMG signals **(K4)**

CO5: Develop an interest to simulate the models and validate its functionality in real time systems. **(K4)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Preliminaries: Concept of Biological signals – Electrical, Mechanical, Chemical, Magnetic, Optical etc. Origin of electrical signal from Biological cell – Structure of Biological cell, Characteristics of Cell membrane, Distribution and movement of ions across the cell membrane, Generation of Biological cell Action Potential. Concept of Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Phonocardiogram (PCG), Electrooculogram (EOG), Respiratory signals etc.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the origin, properties of biomedical signals like ECG, EEG, PCG, ENG and EOG signals. (L2)
- Explain the structure and characteristics of various signals. (L3)

<u>UNIT – II</u> (9 Hrs)

Signal Conditioning: Band limiting of different Biological signals, Representation of biological signals in analog, discrete and digital forms. **Filtering for Removal of artifacts -** Statistical Preliminaries, Time domain filtering - Synchronized Averaging, Moving Average Filter to Integration, Derivative-based operator, **Frequency Domain Filtering** – FIR and IIR methods for implementing Notch, band selective filters, Weiner, Adaptive Filtering concepts.

Learning Outcomes: At the end of this unit, students should be able to

- Understand classical and modern filtering and compression techniques required for biomedical signal processing. (L2)
- Compare different filtering techniques. (L4)

<u>UNIT – III</u> (9 Hrs)

Electrocardiogram (ECG) Analysis: Concepts of morphological and rhythm analysis, Different types of arrhythmias, Derivative based Approaches for QRS Detection, Pan Tompkins Algorithm, Concepts of detecting the P, T waves, PR, ST intervals, QRS duration, etc. Heart Rate Variability (HRV) study and its importance.

Learning Outcomes: At the end of this unit, students should be able to

- Apply filters to remove noise, signal compression techniques & averaging technique on biomedical signals and extract the features of ECG signals. (L3)
- Analyze the nature of biomedical signals and related concepts, and event detection techniques for ECG signals (L4)

<u>UNIT – IV</u> (9 Hrs)

EEG, EMG signals Analysis: Basics of EEG and EMG signals. Signal strength, Signal entropy in time and frequency domain, Correlation coefficient, Envelop Extraction, Root Mean Square value, Zero-crossing rate, Form factor, Periodogram, Minimum phase correspondent, Power Spectral Density concepts in analyzing EEG and EMG signals.

Learning Outcomes: At the end of this unit, students should be able to

- Apply filters to remove noise, signal compression techniques and averaging technique on biomedical signals and extract the features of EEG and EMG signals. (L3)
- Analyze the nature of biomedical signals and related concepts, and event detection techniques for EEG and EMG signals. (L4)

UNIT – V (9 Hrs)

Modelling of Biomedical Systems: Motor unit firing pattern, Cardiac rhythm, Formants and pitch of speech, Point process, Parametric system modelling, Autoregressive model, Autocorrelation method, Application to random signals, Computation of model parameters, Levinson-Durbin algorithm, Computation of gain factor, Covariance method, Spectral matching and parameterization, Model order selection, Relation between AR and Cepstral coefficients, ARMA model, Sequential estimation of poles and zeros.

Learning Outcomes: At the end of this unit, students should be able to

- Demonstrate an ability to integrate different concepts to develop new models that suits current trends of Industries and analyze its performance. (L2)
- Develop an interest to simulate the models and validate its functionality in real time systems. (L4)

TEXTBOOKS:

1. "Biomedical Signal Analysis: A case Based Approach", R M Rangayyan, IEEE Press, John Wiley & Sons. Inc, 2002.
2. "Biomedical Digital Signal Processing", Willis J. Tompkins, EEE, PHI, 2004.
3. "Biomedical Signal Processing: Principles and Techniques", D C Reddy, Tata McGraw-Hill Publishing Co. Ltd, 2005.

REFERENCE BOOKS:

1. "Signals and Systems in Biomedical Engineering: Physiological Systems Modeling and Signal Processing", Suresh R Devasahayam, Springer, 3rd Edition, 2019.
2. "Medical Instrumentation: Application & Design", J G Webster, John Wiley & Sons Inc., 2001.

Course Code	RADAR ENGINEERING		L	T	P	C
21A040434			3	0	0	3
Pre-requisite	Analog Communications	Semester	VII			

COURSE OBJECTIVES:

- To understand the Radar fundamentals and analysis of radar signals.
- To understand various technologies involved in the design of radar transmitters and receivers.
- To learn and compare MTI, Doppler and tracking radars.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain the basic principle of radar and radar range equation. **(K3)**
CO2: Explain the working principle of various radar transmitters and receivers. (**K3**)
CO3: Distinguish between various radars like MTI, Doppler and tracking radar (**K3**)
CO4: Discriminate various Radar tracking techniques. (**K4**)
CO5: Analyze different beam formers and Matched Filter in Radar receivers (**K4**)

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

BASICS OF RADAR: Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Illustrative Problems.

RADAR EQUATION: SNR, Envelope Detector, False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the working of Radar and its specifications (L2)
- Explain the Radar Equation. (L3)

UNIT – II (9 Hrs)

Continuous Wave (CW) RADAR: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Illustrative Problems.

Frequency Modulated – CW Radar: Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar.

Learning Outcomes: At the end of this unit, students should be able to

- Apply Doppler effect to realise the CW and FM-CW radar. (L3)
- Analyse the receiver bandwidth requirements (L4).
- Distinguish between the stationary and moving targets (L4)

UNIT – III (9 Hrs)

MTI AND PULSE DOPPLER RADAR: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, and Staggered PRFs. Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler radar.

Learning Outcomes: At the end of this unit, students should be able to

- Analyze the working of MTI radar. (L4)
- Understand the characteristics of delay line cancellers. (L3)
- Apply concept of staggered PRF to overcome blind spots in MTI Radar (L3)

UNIT – IV (9 Hrs)

TRACKING RADAR: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two- coordinates), Phase Comparison Monopulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

Learning Outcomes: At the end of this unit, students should be able to

- Identify the design considerations of various tracking Radar techniques. (L2)
- Understand the operation of one and two coordinate Radar tracking techniques. (L2)
- Compare Radar tracking techniques (L4)

UNIT – V (8 Hrs)

DETECTION OF RADAR SIGNALS IN NOISE: Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise.

RADAR RECEIVERS: Noise Figure and Noise Temperature, Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Series versus Parallel Feeds, Applications, Advantages and Limitations.

Learning Outcomes: At the end of this unit, students should be able to

- Analyse the characteristics of matched filters. (L4)
- Explain the operation of various radar receivers. (L3)

- Understand to locate the target with the help of radar displays. (L2)

TEXTBOOKS:

1. "Introduction to Radar Systems", Merrill I. Skolnik, TMH Special Indian Edition, 2nd Edition, 2007.

REFERENCE BOOKS:

1. "Introduction to Radar Systems", Merrill I. Skolnik, 3rd Edition, Tata McGraw-Hill, 2001.
2. "Radar Principles, Technology, Applications", Byron Edde, Pearson Education, 2004.
3. "Radar Principles", Peebles, Jr., P. Z. Wiley, New York, 1998

Course Code	DIGITAL IMAGE PROCESSING		L	T	P	C
21A040435			3	0	0	3
Pre-requisite	Signals and systems	Semester	VII			

COURSE OBJECTIVES:

- To introduce fundamentals of Image Processing.
- To know about various techniques of image enhancement and reconstruction.
- To teach various color models and color image enhancement
- To dissimilate various segmentation techniques for images.
- To impart concepts of various coding techniques for image compression.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Analyze various types of images mathematically. **(K4)**

CO2: Analyze images in the frequency domain using various transforms. **(K4)**

CO3: Compare image enhancement methods in spatial and frequency domains. **(K3)**

CO4: Apply various segmentation and restoration algorithms for processing an image. **(K3)**

CO5: Categorize various compression techniques and color models. **(K4)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Digital Image Fundamentals: Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighbourhood, adjacency, connectivity, distance measures. Mathematical tools/ operations applied on images.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the basic building blocks of image processing. (L2)
- Define image processing parameters such as adjacency and distance measures. (L1)
- Analyze various types of images mathematically. (L4)

UNIT – II (9 Hrs)

Image transforms: 2D Orthogonal and Unitary Transforms and their properties - Fast Algorithms - Discrete Fourier Transform - Discrete Cosine Transforms- Walsh- Hadamard Transforms, Hoteling Transforms, Comparison of properties of the above.

Learning Outcomes: At the end of this unit, students should be able to

- Apply various image transforms for converting spatial domain into frequency domain (L3)
- Compare various properties of image transformation techniques(L4)

UNIT – III (9 Hrs)

Image Enhancements and Filtering: Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, frequency domain filters – low-pass and high-pass.

Learning Outcomes: At the end of this unit, students should be able to

- Apply spatial domain and frequency Domain filtering techniques for image enhancement (L3)
- Compare image enhancement methods in spatial and frequency domains (L2)

UNIT – IV (9 Hrs)

Image Restoration: Degradation model, Algebraic approach to restoration – Inverse filtering – Least Mean Square filters, Constrained Least square restoration, Blind Deconvolution.

Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation.

Learning Outcomes: At the end of this unit, students should be able to

- Apply various segmentation and restoration algorithms for processing an image. (L3)
- Illustrate detection of discontinuities in an image (L2)

UNIT – V (9 Hrs)

Image Compression: Redundancies in Images, Compression models, Huffman Coding, Arithmetic coding, Bit plane coding, Run length coding, Transform coding, Still image compression standards – JPEG and JPEG-2000.

Color Image Processing: Color Image Processing-Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image enhancement.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the need for compression (L2)
- Categorize various techniques of compression (L4)
- Categorize various color models for color image processing (L4)

TEXTBOOKS:

1. "Digital Image Processing", R.C. Gonzalez and R.E. Woods, Pearson Education, 2nd Edition, 2008.
2. "Fundamentals of Digital Image Processing", Anil Kumar Jain, Prentice Hall of India, 2nd Edition 2004.

REFERENCE BOOKS:

1. "Digital Image processing using MATLAB", Rafael C. Gonzalez, Richard E woods and Steven L. Eddins, Tata McGraw Hill, 2010.
2. "Image Processing, Analysis, and Machine Vision", Milan Sonka, Vaclav Hlavac, Roger Boule, Cengage Learning, 3rd Edition, 2016.
3. "Digital Image processing", S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill.
4. "Digital Image Processing", William K. Pratt, John Wiley, 3rd Edition, 2004.

ONLINE LEARNING RESOURCES:

1. https://www.udemy.com/course/learn-image-analysis/
2. https://alison.com/tag/image-processing
3. https://nptel.ac.in/courses/117/105/117105135/

Course Code	**ADVANCED MICROPROCESSORS**		**L**	**T**	**P**	**C**
21A040436			**3**	**0**	**0**	**3**
Pre-requisite	Microprocessors and Microcontrollers	Semester	VII			

COURSE OBJECTIVES:

- To study the programming model and architectures of advanced processors
- To understand the architectural features of the 80386, 80486, Pentium processors.
- To learn about the protected mode software model of the 80386 including segmentation, protection, paging and multitasking.
- To understand the need and features of arithmetic coprocessor

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain the architecture and features of advanced microprocessors **(K3)**
CO2: Discuss the architectural features and memory management of 80386 and 80486 processors **(K3)**
CO3: Explain the features of Pentium and Pentium pro processors **(K3)**
CO4: Describe the features of Pentium II, Pentium III, Pentium 4 and Core2 processors **(K3)**
CO5: Explain the internal structure of 80x87 arithmetic coprocessor and its features **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

The Microprocessor and its architecture: The programming model, multipurpose registers, real mode memory addressing, segments and offsets, protected mode memory addressing, selectors and descriptors, memory paging, the page directory and page table, pipelining, pipeline hazards, instruction level parallelism, Reduced Instruction Set Computer principles, RISC versus CISC.

Learning Outcomes: At the end of this unit, students should be able to

- Discuss the programming model and registers of 80x86 processor (L2)
- Explain the memory segmentation, virtual memory and paging mechanism (L3)
- Explain RISC and CISC processor architectures (L3)

UNIT – II (9 Hrs)

The 80386 and 80486 microprocessors: Salient features and architecture of the 80386, memory system of the 80386, special 80386 registers, memory management, protected virtual addressing, virtual 8086 mode, the memory paging Mechanism, Salient features and architecture of the 80486 microprocessor.

Learning Outcomes: At the end of this unit, students should be able to

- Discuss the features of 80386 and 80486 microprocessors (L3)
- Explain the memory management of 80386/80486? (L3)
- Describe the protected mode and virtual 8086 mode of 80386 (L2)

UNIT – III (9 Hrs)

The Pentium and Pentium Pro microprocessors:

Pentium CPU Architecture, Superscalar organization, Pipelining, memory system, branch predication, floating point unit, special Pentium registers, Pentium memory management, new Pentium instructions, Pentium pro architecture and features

Learning Outcomes: At the end of this unit, students should be able to

- Discuss the features of Pentium and Pentium pro microprocessors (L3)
- Explain the memory management of Pentium processor (L3)
- Describe about the branch prediction logic in Pentium processor (L2)

UNIT – IV (9 Hrs)

The Pentium II, Pentium III, Pentium IV and Core 2 microprocessors

Introduction to the Pentium II, memory map of Pentium II based computer system, Pentium II software changes, salient features of Pentium III, Pentium 4 and Core2 microprocessors, multiple core technology, hyper-threading technology, model specific registers, performance monitoring registers, 64-bit extension technology

Learning Outcomes: At the end of this unit, students should be able to

- Discuss the features of Pentium II, Pentium III, Pentium 4 and Core2 microprocessors (L3)
- Describe the multiple core technology and hyper-threading technology (L2)
- Explain the model specific registers and performance monitoring registers (L3)

UNIT – V (9 Hrs)

Arithmetic Coprocessor, MMX and SSE technologies: Data formals for the arithmetic Coprocessor, Internal Structure of 8087 and Advanced Coprocessors, MMX and SSE Technologies, Instruction Set (brief treatment).

Learning Outcomes: At the end of this unit, students should be able to

- Describe the data formats for arithmetic coprocessor (L2)
- Explain the internal structure of 8087 arithmetic coprocessor (L3)
- Discuss about MMX and SSE technologies (L3)

TEXTBOOKS:

1. "The Intel Microprocessors", Barry, B. Brey, Pearson Education, 8th Edition, 2009.
2. "Advanced Microprocessor and Peripherals", A.K. Ray and K.M. Bhurchandi, TMH.
3. "Advanced Microprocessors", Daniel Tabak, McGraw Hill. Inc., 1995

REFERENCE BOOKS:

1. "The Pentium Microprocessor", James L. Antonakos, Pearson Education , 1997.
2. "Micro Computer Engineering", Gene .H. Miller, Pearson Education , 2003.
3. "Microprocessors and Interfacing", Douglas V. Hall, Special Indian Edition, 2006

Course Code	NANO ELECTRONICS		L	T	P	C
21A040437			3	0	0	3
Pre-requisite	Applied Chemistry, Electronic Devices and Circuits	Semester	VII			

COURSE OBJECTIVES:

- To choose different models of MOS devices according to the requirement.
- To teach nano electronic systems and its building blocks
- To provide knowledge on spin electronic devices.
- To familiarize students with the present research trend in Nano electronics.
- To compare MOSFET, CNFET and Spin FET devices.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Describe the limitations of scaling down oxide layer to below 100nm. **(K3)**
CO2: Analyse MOSFETS with different gate structures. **(K4)**
CO3: Model the device with basic quantum structures. **(K3)**
CO4: Analyse different hetero structures. **(K4)**
CO5: Discuss various carbon nano tube FETS. **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Challenges going to sub-100 nm MOSFETs Oxide layer thickness, tunneling, power density, non-uniform dopant concentration, threshold voltage scaling, lithography, hot electron effects, sub-threshold current, velocity saturation, interconnect issues, fundamental limits for MOS operation.

Learning Outcomes: At the end of this unit, students should be able to

- Identify the challenges in scaling down oxide layer. (L2)
- Understand the fundamental limits of MOS operation. (L2)
- Effect on MOS operation due to different parametric changes. (L3)

UNIT – II (9 Hrs)

Novel MOS-based devices Multiple gate MOSFETs, Silicon-on-insulator, Silicon-on-nothing, Fin FETs, vertical MOSFETs, strained Si devices.

Learning Outcomes: At the end of this unit, students should be able to

- Describe the operation of different gate structure transistors. (L2)
- Compare different MOSFET transistors. (L3)
- Identify the transistors suitable for different applications. (L2)

<u>UNIT – III</u> (9 Hrs)

Quantum structures quantum wells, quantum wires and quantum dots, Single electron devices charge quantization, energy quantization, Coulomb blockade, Coulomb staircase, Bloch oscillations.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts of quantum structures. (L2)
- Model the devices using quantum structures. (L3)

<u>UNIT – IV</u> (9 Hrs)

Hetero structure based devices Type I, II and III hetero junctions, Si-Ge hetero structure, hetero structures of III-V and II-VI compounds - resonant tunneling devices.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the significance of different compound structures. (L2)
- Compare different hetero structures. (L3)

<u>UNIT – V</u> (9 Hrs)

Carbon nano tubes based devices CNFET, characteristics; Spin-based devices spin FET, characteristics, Applications of MOSFET, CNFET and Spin FET devices.

Learning Outcomes: At the end of this unit, students should be able to

- Acquire the knowledge on different CNT devices. (L2)
- Compare CNFET and spin FET devices. (L3)

<u>TEXTBOOKS:</u>

1. “Nano electronics Principles & devices”, Mircea Dragoman and Daniela Dragoman, Artech House Publishers, 2005.
2. “Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices”, Karl Goser, Springer 2005.

<u>REFERENCE BOOKS:</u>

1. “Nanoscale Transistors: Device Physics Modelling and Simulation”, Mark Lundstrom and Jing Guo, Springer, 2005.
2. “Quantum hetero structures”, Vladimir V Mitin, Viatcheslav A Kochelap and Michael A Stroscio, Cambridge University Press, 1999.
3. “High speed semiconductor devices”, S M Sze (Ed), Wiley, 1990.

Course Code	MANAGEMENT SCIENCE (Common to all Branches)		L	T	P	C
21A110204			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To provide fundamental knowledge on Management, Administration, Organization & its concepts.
- To make the students understand the role of management in Production
- To impart the concept of HRM in order to have an idea on Recruitment, Selection, Training& Development, job evaluation and Merit rating concepts
- To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management
- To make the students aware of the contemporary issues in management

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Apply the concepts and principles of management in real life industry design and develop organization chart and structure for an enterprise. **(K3)**
CO2: Apply operations management techniques in real life industry. **(K3)**
CO3: Apply the concepts of HRM in Recruitment, Selection, Training & Development. **(K3)**
CO4: Develop PERT/CPM charts for projects of an enterprise and estimate time & cost of a project and to develop Mission, Objectives, Goals & Strategies for an enterprise in dynamic environment. **(K3)**
CO5: Understand & apply modern management techniques wherever possible. **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction to Management: Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor's Scientific Theory-Henry Fayol's principles - Eltan Mayo's Human relations - Systems Theory - **Organisational Designs** - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of management and organization (L2)

- Apply the concepts & principles of management in real life industry (L3)
- Analyze the organization chart & structure for an enterprise.(L4)
- Evaluate and interpret the theories and the modern organization theory (L5)

UNIT – II (10 Hrs)

Operations Management: Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control- Deming's contribution to Quality. **Material Management** - Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - Purchase Procedure and Stores Management - **Marketing Management -** Concept - Meaning - Nature-Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the core concepts of Management Science and Operations Management (L2)
- Apply the knowledge of Quality Control, Work-study principles in real life industry (L3)
- Evaluate Materials departments & Determine EOQ (L5)
- Analyze Marketing Mix Strategies for an enterprise (L4)
- Create and design advertising and sales promotion (L5)

UNIT – III (6 Hrs)

HUMAN RESOURCES MANAGEMENT: HRM - Definition and Meaning – Nature - Managerial and Operative functions - Evolution of HRM - Job Analysis - Human Resource Planning (HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process and Tests in Employee Selection - Employee Training and Development - On-the- job & Off-the-job training methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts of HRM in Recruitment, Selection, Training & Development (L2)
- Apply Managerial and Operative Functions (L3)
- Analyze the need of training (L4)
- Evaluate performance appraisal (L5)
- Design the basic structure of salaries and wages (L5)

UNIT – IV (12 Hrs)

Strategic & Project Management: Definition& Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis - **Project Management -** Network Analysis - Programme

Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).

Learning Outcomes: At the end of this unit, students should be able to

- Understand Mission, Objectives, Goals & Strategies for an enterprise (L2)
- Apply SWOT Analysis to strengthen the project (L3)
- Analyze Strategy formulation and implementation (L4)
- Evaluate PERT and CPM Techniques (L5)
- Create in competing the projects within given time (L5)

<u>UNIT – V</u> (8 Hrs)

Contemporary Issues in Management: The concept of Management Information System(MIS) - Materials Requirement Planning (MRP) - Customer Relations Management(CRM) - Total Quality Management (TQM) - Six Sigma Concept - Supply Chain Management(SCM) - Enterprise Resource Planning (ERP) - Performance Management - Business Process Outsourcing (BPO) - Business Process Re-engineering and Bench Marking - Balanced Score Card - Knowledge Management.

Learning Outcomes: At the end of this unit, students should be able to

- Understand modern management techniques (L2)
- Apply Knowledge in modern management (L3)
- Analyze CRM, TQM (L4)
- Evaluate Six Sigma concept and SCM (L5)

<u>TEXTBOOKS:</u>

1. “Management Science”, A.R Aryasri, TMH, 2013
2. “Management”, Stoner, Freeman, Gilbert, Pearson Education, New Delhi, 2012.

<u>REFERENCE BOOKS:</u>

1. “Essentials of Management”, Koontz &Weihrich, TMH, 6th Edition, 2005.
2. “Management Principles and Guidelines”, Thomas N. Duening & John M. Ivancevich, Biztantra.
3. “Production and Operations Management”, Kanishka Bedi, Oxford University Press, 2004.
4. “Modern Management”, Samuel C. Certo, 9th Edition, PHI, 2005

Course Code	SOFTWARE TESTING TOOLS		L	T	P	C
21A050707			1	0	2	2
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To understand what is testing? and Software development model.
- To describe different approaches to Testing and testing methodologies.
- To demonstrate how to write and execute test plans
- To illustrate the basic concepts of automation testing
- To discuss about Test NG and other important concepts in automation testing.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand the basic concepts of testing and SDLC Models. **(K2)**
CO2: Examine STLC and different types of testing and defects. **(K3)**
CO3: Analyze automation testing and its elements and time functions. **(K4)**
CO4: Demonstrate different Popups in automation testing. **(K3)**
CO5: Analyze various Test NG Frameworks. **(K4)**

CO-PO MAPPING:

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

MODULE – I:

Manual Testing: Introduction, Error, Defect, Bug, Verification, Validation. Testing: Types of Testing, White box and Black box Testing. Software Development Life Cycle : Introduction to Software Development Life Cycle, Models for SDLC, Metrics for Projects.

MODULE – II:

Software Testing Life Cycle: Basic Concepts, Testing Methodologies, Test Plans, Test Cases, Test Executions and Defect Reports. **Defects:** Types of Defects, Defect Life Cycle, Levels vs Builds, Priority and Severity. **Types of Testing:** Functionality Testing, Security Testing, Smoke Testing, Sanity Testing, Adhoc Testing, Exploratory Testing, Load Testing, Stress Testing, Regression Testing, Retesting.

MODULE – III:

Automation Testing: Introduction to Selenium, Components in Selenium, Installation Process, Cross Browser, Parallel Testing, Web Driver Methods and Locators. **Working on the Elements:** Links, Dropdown, Radio Buttons, Check Boxes, Web Tables, Actions. **Time Functions:** Implicit, Explicit, Page Load Functions, Scroll Functions.

MODULE – IV:

Working on Popups: Alerts, Prompts, Confirmation, Working on Frames and Windows, Introduction to Test NG Designs, Annotations in TestNG. Apache POI Jar Files 3.17 for Reading, Writing Excel Files. Page Object Model-Property List.

MODULE – V:

Test NG Frameworks: Framework Designing Structure, Keyword Framework, Data Driven Framework, Linear Framework, Modular Framework, Hybrid Framework. Working on Maven Project – Creating Extent Reports, Basics of Github and Jenkins.

LIST OF EXPERIMENTS:

Week 1 :

Write a ‘C’ program to demonstrate the working of the following constructs:

a). do…while
b). while
c). if …else
d). switch
e). for Loops in C language.

Week 2 :

A program written in c language for matrix multiplication fails “Introspect the causes for its failure and write down the possible reasons for its failure”.

Week 3 :

A) Take any system (e.g. ATM system) and study its system specifications and report the various bugs.

B) Write the test cases for any known application (e.g. Banking application)

C) Create a test plan document for any application (e.g. Library Management System.

Week 4 :

Write a script to open google.com and verify that title is Google and also verify that it is redirected to google.co.in

Week 5 :
Write a script to open google.co.in using chrome browser (ChromeDriver).

Week 6 :
Write a script to open google.co.in using internet explorer (InternetExplorerDriver).

Week 7 :
Write a script to login Next Generation Automation.

Week 8 :
Write a script to close all the browsers without using quit() method.

Week 9 :
Write a script to test the Gmail Login & Logout procedure .

Week 10 :
Write a script to test the Facebook Account Creation .

Week 11 :
Write a script to test the Google Cache Selection.

Week 12 :
Write a script to test the Gmail Composing Dynamically.

REFERENCE BOOKS:

1. "Software Testing: Principles and Practices", Srinivasan Desikan, Gopalaswamy Ramesh, 1st Edition, Pearson Education.
2. "Software Testing: Principles and Practices", Naresh Chauhan, 2nd Edition, Oxford University Press
3. "Java Complete Reference", Herb Schildt, 9th Edition , Oracle press.

OPEN ELECTIVE – I

Course Code	AIR POLLUTION AND CONTROL		L	T	P	C
21A010501			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- To identify the sources of air pollution
- To know the composition and structure of atmosphere
- To know the pollutants dispersion models
- To understand the working of air pollution control equipment
- To identify the sources of noise pollution and their controlling methods.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Identify the sources of air pollution. **(K2)**
CO2: Explain the composition and structure of atmosphere. **(K4)**
CO3: Discuss the general characteristics of stack emissions and their behavior. **(K2)**
CO4: Understand the mechanism of Control of air pollutants. **(K2)**
CO5: Know about the noise sources, mapping, prediction equations etc. **(K2)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction: sources, effects on – ecosystems, characterization of atmospheric pollutants, air pollution episodes of environmental importance. Indoor Air Pollution– sources, effects.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the character of atmospheric pollutants and their effect. (L4)

UNIT – II (9 Hrs)

Meteorology - composition and structure of the atmosphere, wind circulation, solar radiation, lapse rates, atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature Inversions, Wind rose diagram.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the composition and structure of atmosphere. (L4)
- Write the maximum mixing depth and windrose diagram. (L6)

UNIT – III (9 Hrs)

General characteristics of stack emissions, plume behavior, heat island effect. Pollutants dispersion models – description and application of point, line and areal sources. Monitoring of particulate matter and gaseous pollutants –respirable, non-respirable and nano - particulate matter. CO, CO2, Hydrocarbons (HC), SOX and NOX, photochemical oxidants.

Learning Outcomes: At the end of this unit, students should be able to

- Express about the general characteristics of stack emissions and their behavior. (L6)
- Analyze the monitoring of particulate matter and gaseous pollutants. (L4)

UNIT – IV (9 Hrs)

Air Pollution Control equipment for particulate matter & gaseous pollutants– gravity settling chambers, centrifugal collectors, wet collectors, fabric filters, electrostatic precipitator (ESP). – Adsorption, Absorption, Scrubbers, Condensation and Combustion.

Learning Outcomes: At the end of this unit, student should be able to

- Explain the various air pollution control equipment. (L3)

UNIT – V (9 Hrs)

Noise - sources, measurements, effects and occupational hazards. Standards, Noise mapping, Noise attenuation equations and methods, prediction equations, control measures, Legal aspects of noise.

Learning Outcomes: At the end of this unit, students should be able to

- Assess the noise sources, mapping, prediction equations etc., (L5)

TEXTBOOKS:

1. “Air Pollution - Its Origin and Control”, Wark K., Warner C.F., and Davis W.T, Harper & Row Publishers, New York.
2. “Environmental Engineering”, H.S. Peavy, D.R. Row & G. Tchobanoglous, Mc Graw Hill International Edition

REFERENCE BOOKS:

1. “Air Pollution”, Perkins H.C., McGraw Hill.
2. “Air Pollution Control Theory”, Crawford M., TATA McGraw Hill.
3. “Air Pollution”, Stern A.C., Volume I, II, III.
4. “Air Pollution”, Seinfeld N.J., McGraw Hill.
5. “Air Quality Management”, Stern A.C., Volume V.
6. “Air Pollution”, M N Rao and HVN Rao, Tata McGraw Hill publication

ONLINE LEARNING RESOURCES:

1. http://www.epa.gov
2. http://www.indiaenvironmentportal.org.in
3. http://nptel.iitm.ac.in
4. http://www.filtersource.com

Course Code	ELECTRIC VEHICLES		L	T	P	C
21A020501			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- Get exposed to new technologies of battery electric vehicles, fuel cell electric vehicles
- Get exposed to EV system configuration and parameters
- Know about electro mobility and environmental issues of EVs
- Understand about basic EV propulsion and dynamics
- Understand about fuel cell technologies for EV and HEVs
- Know about basic battery charging and control strategies used in electric vehicles

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand and differentiate between conventional and latest trends in Electric vehicles. **(K2)**

CO2: Analyze various EV resources, EV dynamics and Battery charging. **(K4)**

CO3: Apply basic concepts of EV to design complete EV system. **(K3)**

CO4: Design EV system with various fundamental concepts. **(K5)**

CO5: Analyze the various control strategies used in battery charging in the electric vehicles. **(K4)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction to EV Systems and Parameters: Past, Present and Future EV, EV Concept, EV Technology, State-of-the Art EVs, EV configuration, EV system, Fixed and Variable gearing, single and multiple motor drive, in-wheel drives, EV parameters: Weight, size, force and energy, performance parameters.

Learning Outcomes: At the end of this unit, students should be able to

- Apply basic concepts of EV to design complete EV system. (L3)
- Explain EV system configuration. (L3)
- Understand various EV parameters. (L2)

UNIT – II (9 Hrs)

EV and Energy Sources: Electro mobility and the environment, history of Electric power trains, carbon emissions from fuels, green houses and pollutants, comparison of conventional, battery, hybrid and fuel cell electric systems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand electro mobility and environmental issues of EVs. (L2)
- Explain the history of Electric power trains. (L3)
- Compare conventional, battery, hybrid and fuel cell electric systems. (L3)

UNIT – III (9 Hrs)

EV Propulsion and Dynamics: Choice of electric propulsion system, block diagram, concept of EV Motors, single and multi-motor configurations, fixed and variable geared transmission, In-wheel motor configuration, classification, Electric motors used in current vehicle applications, Recent EV Motors, Vehicle load factors.

Learning Outcomes: At the end of the unit, the student will be able to

- Sketch the block diagram of EV system. (L2)
- Choose a suitable electric propulsion system. (L2)
- Classify EV motors and their applications. (L3)

UNIT – IV (9 Hrs)

Fuel Cells: Introduction of fuel cells, basic operation, model, voltage, power and efficiency, power plant system – characteristics, sizing, Example of fuel cell electric vehicle.

Introduction to HEV, brake specific fuel consumption, comparison of series, series-parallel hybrid systems, examples.

Learning Outcomes: At the end of this unit, students should be able to

- FUEL CELLS: Explain the working principle of Fuel cells. (L3)
- Analyze fuel cell technologies for EV and HEVs. (L4)
- Compare series, series-parallel hybrid systems. (L3)

UNIT – V (9 Hrs)

Battery Charging and Control: Battery charging: Basic requirements, charger architecture, charger functions, wireless charging, power factor correction.

Control: Introduction, modeling of electromechanical system, feedback controller design approach, PI controllers designing, torque-loop, speed control loop compensation.

Learning Outcomes: At the end of this unit, students should be able to

- Understand basic battery charging in Electric Vehicles. (L2)
- Analyze control strategies used in electric vehicles. (L4)

TEXTBOOKS:

1. "Modern Electric Vehicle Technology", C.C Chan, K.T Chau, Oxford University Press Inc., New York 2001.

2. “Electric Vehicle Technology Explained”, James Larmenier, John Lowry, Wiley, 2003.

REFERENCE BOOKS:

1. “Electric and Hybrid Vehicles Design Fundamentals”, Iqbal Husain, CRC Press 2005.
2. “Advanced Electric Drive Vehicles”, Ali Emadi, CRC Press, 2015.

ONLINE LEARNING RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ee53/preview

Course Code	ELECTRICAL DISTRIBUTION SYSTEMS		L	T	P	C
21A020502			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- The classification of distribution systems
- The aspects and design considerations in DC and AC distribution and their comparison
- Technical issues of substations such as location, ratings and bus bar arrangements
- The causes of low power factor and methods to improve power factor
- The principles in Distribution automation

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Compute the various factors associated with power distribution. **(K3)**
CO2: Make voltage drop calculations in given distribution networks. **(K3)**
CO3: Learn principles of substation maintenance. **(K2)**
CO4: Compute power factor improvement for a given system and load. **(K3)**
CO5: Understand implementation of SCADA for distribution automation. **(K2)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Load Modeling and Characteristics: Introduction to Distribution Systems, Load Modelling and Characteristics. Coincidence Factor, Contribution Factor Loss Factor - Relationship between the Load Factor and Loss Factor. Classification of Loads (Residential, Commercial, Agricultural, and Industrial) and Their Characteristics.

Learning Outcomes: At the end of the unit, students should be able to

- Understand the basic concepts of the electrical distribution systems. (L2)
- Analyze the relationship between load factor and loss factor. (L4)
- Understand the various loads and its characteristics. (L2)

UNIT – II (9 Hrs)

Classification Of Distribution Systems: Classification of Distribution Systems - Comparison of DC vs AC and Under-Ground vs Over - Head Distribution Systems- Requirements and Design Features of Distribution Systems. Design Considerations of Distribution Feeders: Radial and Loop

Types of Primary Feeders, Voltage Levels, Feeder Loading, Basic Design Practice of the Secondary Distribution System.

Learning Outcomes: At the end of the unit, students should be able to

- Understand the classification of electrical distribution systems. (L2)
- Analyze the design considerations of the radial and loop type feeders. (L4)

UNIT – III (9 Hrs)

Substations: Location of Substations: Rating of Distribution Substation, Service Area within Primary Feeders. Benefits Derived Through Optimal Location of Substations. Classification of Substations: Air Insulated Substations - Indoor & Outdoor Substations: Substation Layout showing the Location of all the Substation Equipment. Bus Bar Arrangements in the Sub-Stations: Simple Arrangements Like Single Bus Bar Sectionalized Single Bus Bar, With Relevant Diagrams.

Learning Outcomes: At the end of the unit, students should be able to

- Understand the layout of the substation and various equipment installed. (L2)
- Analyze the classification of the substation based on insulating medium. (L4)
- Understand various bus bar schemes in substation. (L2)

UNIT – IV (9 Hrs)

Power Factor Improvement: Three Phase Balanced Primary Lines. Causes of Low P.F - Methods of Improving P.F -Phase Advancing and Generation of Reactive KVAR Using Static Capacitors-Most Economical P.F. for Constant KW Load and Constant KVA Type Loads, Capacitive Compensation for Power-Factor Control - Effect of Shunt Capacitors (Fixed and Switched), Power Factor Correction.

Learning Outcomes: At the end of the unit, students should be able to

- Analyze the voltage drop and power loss calculations in manual lines. (L4)
- Understand the power factor compensation methods in the lines. (L2)
- Apply various power factor correction methods using fixed and switched capacitors. (L3)

UNIT – V (9 Hrs)

Distribution Automation: Distribution Automation (DA) – Project Planning – Definitions – Communication Sensors- Supervisory Control and Data Acquisition (SCADA) – Consumer Information Service (CIS) – Geographical Information System (GIS) – Automatic Meter Reading (AMR) – Automation Systems.

Learning Outcomes: At the end of the unit, students should be able to

- Analyze the voltage drop and power loss calculations in manual lines. (L4)
- Understand the power factor compensation methods in the lines. (L2)
- Apply various power factor correction methods using fixed and switched capacitors. (L3)

TEXTBOOKS:

1. "Electric Power Distribution Engineering", Turan Gonen, CRC Press, 3rd Edition, 2014.
2. "Electric Power Distribution", A.S. Pabla, Tata Mc Graw Hill (India) Pvt. Ltd., 6th Edition, 2011.

REFERENCE BOOKS:

1. "Electric Power Distribution Automation", Dr. M. K. Khedkar and Dr. G. M. Dhole, University Science Press, 2010
2. "Electrical Power Distribution Systems", V. Kamaraju, Jain Book Depot, 2012.

Course Code	ROBOTICS		L	T	P	C
21A030501			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- To familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control
- To choose and incorporate robotic technology in engineering systems.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand the introduction and types of robots. **(K2)**

CO2: Analyze kinematics using forward and inverse kinematics and dynamics of robots using transformation, Jacobians, Lagrange – Euler and Newton – Euler formation. **(K4)**

CO3: Understand the working principle of different types of actuators and sensors. **(K2)**

CO4: Understand the motion types and robot programming software. **(K2)**

CO5: Know importance of robotic Applications in manufacturing. **(K2)**

CO-PO MAPPING:

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

UNIT – I (8 Hrs)

Introduction to Industrial Robots: Classification. Robot configurations, Functional line diagram, Degrees of Freedom. Components, common types of arms, joints, grippers.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the basic concepts of robots. (L2)
- Differentiate types of robots and robot grippers. (L4)

UNIT – II (8 Hrs)

Manipulator Kinematics: Homogeneous transformations as applicable to rotation and translation-D-H notation, Forward and inverse kinematics.

Manipulator Dynamics: Differential transformation, Jacobians .Lagrange – Euler and Newton – Euler formations.

Learning Outcomes: At the end of this unit, students should be able to

- Acquire the knowledge about robot kinematics and dynamics. (L2)
- Analyze the forward and inverse kinematics of robot manipulators. (L4)

<u>UNIT – III</u> (9 Hrs)

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison. Position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile sensors, Proximity sensors.

Learning Outcomes: At the end of this unit, students should be able to

- Identify the various types of robot actuators and feedback components. (L1)
- Understand the working of robot sensors. (L2)

<u>UNIT – IV</u> (11 Hrs)

Trajectory Planning: Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion.

Robot programming - Types – features of languages and software packages.

Learning Outcomes: At the end of this unit, students should be able to

- Analyze motion in links and joints of a robot. (L4)
- Understand the types and software packages of robots. (L2)

<u>UNIT – V</u> (9 Hrs)

Robot Application in Manufacturing: Material Transfer -Material handling, loading and unloading - Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

Learning Outcomes: At the end of this unit, students should be able to

- Express the various applications of robots in industries. (L2)
- Acquire the knowledge about real time applications of robots in manufacturing. (L2)

<u>TEXTBOOKS</u>:

1. "Industrial Robotics", M.P. Groover, TMH.
2. "Robotics, Fundamental Concepts and analysis", Ashitave Ghosal, Oxford Press
3. "Robotics and Control", Mittal R K & Nagrath I J, TMH.

<u>REFERENCE BOOKS:</u>

1. "Robotics", Fu K S, McGraw Hill.
2. "An Introduction to Robot Technology", P. Coiffet and M. Chaironze, Kogam Page Ltd. 1983 London.
3. "Robotic Engineering", Richard D. Klafter, Prentice Hall
4. "Introduction to Robotics", John J. Craig, Pearson Edu
5. "Automation, Production systems and CIM", M.P. Groover, Pearson Edu

Course Code	BASICS OF MECHANICAL ENGINEERING		L	T	P	C
21A030502			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- To familiarize students with basic power plants types, turbines, pumps, IC engines, boilers, refrigeration and air conditioning process and their performance aspects.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Know types of power generating plants by using conventional or Non-conventional resources. **(K2)**

CO2: Understand and implementation of turbines, explain different types of pumps and their application. **(K2)**

CO3: Describe To familiarize the developments in IC engines. **(K2)**

CO4: Uunderstand the concept of the boilers. **(K2)**

CO5: Explain the working principles of refrigeration and air conditioning systems. **(K3)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Power Plant Engineering: Introduction – Energy Renewable and Non – Renewable Energy, Sources – Classification of Power Plants based on Sources of Energy – Thermal Power Plant or Steam Power Plant – Hydro Electric Power – Nuclear Fission, Chain Reaction, Layout of Nuclear Power Plant – Diesel Power Plant – Gas Turbine Power Plant – Open Cycle Gas Turbine, Closed Cycle Gas Turbine Power Plant, Comparison of Diesel Power Plant with Gas Turbine Power Plant.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the energy Renewable and Non – Renewable Energy Sources. (L2)
- Illustrate the working principle of Steam, Nuclear & open cycle, and closed cycle gas turbine. (L2)

UNIT – II (10 Hrs)

Hydraulic Turbine – Classification of Hydraulic Turbines, Impulse Turbine, Reaction Turbine, Difference between Impulse and Reaction Turbine.

Pumps – Classification of Pumps, Centrifugal Pump, Applications of Centrifugal Pump, Priming, Reciprocating Pumps, Single Acting Reciprocating Pump, Working of a Double acting Reciprocating Pump, Comparison of Reciprocating Pump with Centrifugal Pump.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the working of Hydraulic Turbines, Impulse Turbine, and Reaction Turbine. (L2)
- Understand the working of Centrifugal Pump, Reciprocating Pumps and Comparison between them. (L2)

<u>UNIT – III</u> (10 Hrs)

I.C Engine: Heat Engine – Types of Heat Engine – External Combustion Engine, IC Engine (Internal Combustion), Classification of I.C. Engine, Two Stroke Petrol Engine, Four Stroke Engine, Valve Timing Diagram, Port Timing Diagram, Comparison of Two Stroke and Four Stroke Engines, Comparison of Petrol Engine and Diesel Engine, Fuel System of a Petrol Engine, Ignition Systems.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the working of External Combustion Engine, IC Engine. (L2)
- Illustrate the working of Two Stroke Petrol Engine, Four Stroke Engine. (L2)

<u>UNIT – IV</u> (7 Hrs)

Boilers: Classification of Boilers – Simple Vertical Boiler – Cochran Boiler – Babcock and Wilcox Boiler – Benson Boiler – Difference between Fire Tube and Water Tube Boilers – Boiler Mountings – Boiler Accessories – Difference between Boiler Mountings and Accessories.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the working of different types Fire Tube and Water Tube Boilers.(L2)

<u>UNIT – V</u> (8 Hrs)

Refrigeration and Air Conditioning: Introduction – Terminology of Refrigeration and Air Conditioning – Properties of Refrigerants – List of Commonly used Refrigerants – Types of Refrigerating System – Vapour Compression Refrigeration System – Vapour Absorption Refrigerator – Domestic Refrigerator – Air Conditioning – Application of Air Conditioning – Psychrometry – Window Air Conditioning.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the working of Vapour Compression Refrigeration System – Vapour Absorption Refrigeration system. (L2)
- Illustrate the working of Air Conditioning. (L2)

TEXTBOOKS:

1. "Basic Civil and Mechanical Engineering", Er. R. Vaishnavi, Prof. V. Vijayan, Prof. M. Prabhakaran, S. Chand Publication, 2nd Edition
2. "Elements of Mechanical Engineering", S Trymbaka Murthy, University Press, 4th Edition

REFERENCE BOOKS:

1. "Elements of Mechanical Engineering", S. N. Lal, Cengage Learning, 2013
2. "Elements of Mechanical Engineering", S. Trymbaka Murthy, Universities Press, 2015
3. "Mechanical Technology", Dr M. Maruthi Rao and V. Pavan Kumar, Lambert Academic Publishing, 2022

Course Code	OPERATING SYSTEMS CONCEPTS		L	T	P	C
21A050501			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- To gain knowledge about the Operating Systems concepts such as process, main memory management, secondary memory management, CPU and disk scheduling etc.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Describe the general architecture of computers **(K2)**
CO2: Describe, contrast and compare differing structures for operating Systems. **(K3)**
CO3: Analyse theory and implementation of: processes, resource control (concurrency etc.), physical and virtual memory, scheduling, I/O and files. **(K4)**
CO4: Understand paging mechanism, virtual memory **(K2)**
CO5: Understand and identify the dead lock and methods to recovery the dead lock **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Computer System and Operating System Overview: Overview of computer operating systems, operating systems functions, protection and security, distributed systems, special purpose systems, operating systems structures and systems calls, operating systems generation.

Learning Outcomes: At the end of this unit, students should be able to

- Identify major components of operating systems. (L1)
- Understand the types of computing environments. (L2)
- Explore several open-source operating systems. (L4)
- Recognize operating system services to users, processes and other systems. (L2)

UNIT – II (10 Hrs)

Process Management – Process concept- process scheduling, operations, Inter process communication. Multi Thread programming models. Process scheduling criteria and algorithms, and their evaluation.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the importance, features of a process and methods of communication between processes. (L2)
- Examine CPU utilization through multi programming and multithreaded programming. (L3)

UNIT – III (8 Hrs)

Concurrency: Process synchronization, the critical- section problem, Peterson's Solution, synchronization Hardware, semaphores, classic problems of synchronization, monitors, Synchronization examples.

Learning Outcomes: At the end of this unit, students should be able to

- Examine the various Problems of Process Synchronization. (L3)

UNIT – IV (8 Hrs)

Memory Management: Swapping, contiguous memory allocation, paging, structure of the page table, segmentation Virtual Memory Management: virtual memory, demand paging, page-Replacement, algorithms, Allocation of Frames, Thrashing.

Learning Outcomes: At the end of this unit, students should be able to

- Examine the various techniques of allocating memory to processes. (L3)
- Summarize how paging works in contemporary computer systems. (L4)
- Understanding the benefits of virtual memory systems. (L2)

UNIT – V (10 Hrs)

Principles of deadlock– system model, deadlock characterization, deadlock prevention, detection and avoidance, recovery form deadlock.

Learning Outcomes: At the end of this unit, students should be able to

- Investigate methods for preventing/avoiding deadlocks. (L4)
- Examine file systems and its interface in various operating systems. (L3)

TEXTBOOKS:

1. "Operating System Concepts", Abraham Silberchatz, Peter B. Galvin, Greg Gagne, John Wiley, 7th Edition.
2. "Operating Systems – Internal and Design Principles", Stallings, Pearson education, 6th Edition, 2005.

REFERENCE BOOKS:

1. "Operating systems- A Concept based Approach", D. M. Dhamdhere, 2nd Edition, Tata McGraw Hill
2. "Operating System – A Design Approach", Crowley, TMH.

3. "Modern Operating Systems", Andrew S Tanenbaum, 3rd Edition, Prentice Hall International.

ONLINE LEARNING RESOURCES:

1. http://nptel.iitm.ac.in/courses/Webcourse-contents/IISc-BANG/Operating%20Systems/New_index1.html

Course Code	COMPUTER ARCHITECTURE & ORGANIZATION		L	T	P	C
21A050502			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- Principles and the Implementation of Computer Arithmetic
- Operation of CPUs including RTL, ALU, Instruction Cycle and Busses
- Fundamentals of different Instruction Set Architectures and their relationship to the CPU Design
- Memory System and I/O Organization
- Principles of Operation of Multiprocessor Systems and Pipelining.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Develop a detailed understanding of computer systems **(K4)**

CO2: Cite different number systems, binary addition and subtraction, standard, floating-point, and micro-operations **(K3)**

CO3: Develop a detailed understanding of architecture and functionality of central processing unit **(K4)**

CO4: Exemplify in a better way the I/O and memory organization **(K3)**

CO5: Illustrate concepts of parallel processing, pipelining and inter processor communication. **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Basic Structure of Computers: Basic Organization of Computers, Historical Perspective, Bus Structures, Data Representation: Data types, Complements, Fixed Point Representation. Floating, Point Representation. Other Binary Codes, Error Detection Codes. Computer Arithmetic: Addition and Subtraction, Multiplication Algorithms, Division Algorithms

Learning Outcomes: At the end of this unit, students should be able to

- Understand the Organization of Computers. (L2)
- Compare various Arithmetic Algorithms. (L5)

UNIT – II (10 Hrs)

Register Transfer Language and Micro operations: Register Transfer language. Register Transfer Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro Operations, Shift

Micro Operations, Arithmetic Logic Shift Unit. Basic Computer Organization and Design: Instruction Codes, Computer Register, Computer Instructions, Instruction Cycle, Memory – Reference Instructions. Input –Output and Interrupt, Complete Computer Description.

Learning Outcomes: At the end of this unit, students should be able to

- Perform various functions using basic logical operations. (L5)
- Apply I/O and interrupts to execute various operations. (L4)

UNIT – III (8 Hrs)

Central Processing Unit: General Register Organization, STACK Organization. Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.

Micro programmed Control: Control Memory, Address Sequencing, Micro Program example, Design of Control Unit.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various addressing Modes. (L1)
- Compare various instruction formats. (L5)
- Design and other issues related to Control Unit. (L4)

UNIT – IV (8 Hrs)

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupts, Direct Memory Access.

Learning Outcomes: At the end of this unit, students should be able to

- Compare various memories. (L3)
- Analyze various modes of transfer. (L5)

UNIT – V (8 Hrs)

Multi Processors: Introduction, Characteristics of Multiprocessors, Interconnection Structures, Inter Processor Arbitration.

Pipeline: Parallel Processing, Pipelining, Instruction Pipeline, RISC Pipeline, Array Processor.

Learning Outcomes: At the end of this unit, students should be able to

- Analyzing various processors. (L5)
- Compare various Pipeline. (L4)

TEXTBOOKS:

1. "Computer System Architecture", M. Morris Mano, Pearson, 3rd Edition, 2008.
2. "Computer Organization", Carl Hamacher, Zvonko Vranesic, Safwat Zaky, McGraw Hill, 5th Edition, 2002.

REFERENCE BOOKS:

1. "Computer Organization and Architecture", William Stallings, Pearson, 6^{th} Edition, 2006.
2. "Structured Computer Organization", Andrew S. Tanenbaum, Pearson, 4^{th} Edition, 2005.
3. "Fundamentals of Computer Organization and Design", Sivarama P. Dandamudi, Springer, 2006.

ONLINE LEARNING RESOURCES:

1. https://www.javatpoint.com/computer-organization-and-architecture-tutorial
2. https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/

OPEN ELECTIVE – II

Course Code	ENVIRONMENTAL POLLUTION AND CONTROL		L	T	P	C
21A010502			3	0	0	3
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- To impart knowledge on aspects of air pollution & control and noise pollution.
- To impart concepts of treatment of waste water from industrial source.
- To differentiate the solid and hazardous waste based on characterization.
- To introduce sanitation methods essential for protection of community health.
- To provide basic knowledge on sustainable development.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand the fundamentals of solid waste management, practices adopted in his town / village and its importance in keeping the health of the city. **(K2)**

CO2: Identify the air pollutant control devices and have knowledge on the NAAQ standards and air emission standards**. (K2)**

CO3: Differentiate the treatment techniques used for sewage and industrial wastewater Treatment. **(K3)**

CO4: Integrate the methods of environmental sanitation and the management of community facilities without spread of epidemics. **(K6)**

CO5: Appraise the importance of sustainable development while planning a project or executing an activity. **(K4)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

AIR POLLUTION:

Air pollution Control Methods–Particulate control devices – Methods of Controlling Gaseous Emissions – Air quality standards. Noise Pollution: Noise standards, Measurement and control methods – Reducing residential and industrial noise – ISO:14000.

Learning Outcomes: At the end of this unit, students should be able to

- Understand control mechanism of air pollutants. (L2)
- Design noise reduction techniques. (L6)

<u>UNIT – II</u> (9 Hrs)

INDUSTRIAL WASTE WATER MANAGEMENT:

Strategies for pollution control – Volume and Strength reduction – Neutralization – Equalization – Proportioning – Common Effluent Treatment Plants – Recirculation of industrial wastes – Effluent standards.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the importance of treatment process of industrial effluents. (L2)
- Design treatment plants. (L6)

<u>UNIT – III</u> (9 Hrs)

SOLID WASTE MANAGEMENT: solid waste characteristics – basics of on-site handling and collection – separation and processing – Incineration- Composting-Solid waste disposal methods – fundamentals of Land filling.

HAZARDOUS WASTE: Characterization – Nuclear waste – Biomedical wastes – Electronic wastes – Chemical wastes – Treatment and management of hazardous waste-Disposal and Control methods.

Learning Outcomes: At the end of this unit, students should be able to

- Categorize of solid waste and separation and procession solid waste. (L4)
- Estimate Hazardous wastes. (L5)
- Develop execute solid waste and hazardous waste management. (L6)

<u>UNIT – IV</u> (9 Hrs)

ENVIRONMENTAL SANITATION: Environmental Sanitation Methods for Hostels and Hotels, Hospitals, Swimming pools and public bathing places, social gatherings (melas and fares), Schools and Institutions, Rural Sanitation-low cost waste disposal methods.

Learning Outcomes: At the end of this unit, students should be able to

- Understand importance of hygienic environment. (L2)
- Choose appropriate rural sanitation methods to keep surrounding clean. (L5)

<u>UNIT – V</u> (9 Hrs)

SUSTAINABLE DEVELOPMENT: Definition- elements of sustainable developments- Indicators of sustainable development- Sustainability Strategies- Barriers to Sustainability– Industrialization and sustainable development – Cleaner production in achieving sustainability- sustainable
development.

Learning Outcomes: At the end of this unit, students should be able to

- Express sustainable development strategies. (L6)

TEXTBOOKS:

1. "Environmental Engineering", Peavy, H. S., Rowe, D.R, Tchobanoglous, Mc-Graw Hill International Editions, New York 1985.
2. "Environmental Science and Engineering", J. G. Henry and G. W. Heinke, Pearson Education.

REFERENCE BOOKS:

1. "Waste water treatment- concepts and design approach", G. L. Karia and R.A. Christian, Prentice Hall of India
2. "Air pollution", M. N. Rao and H. V. N. Rao, Tata Mc.Graw Hill Company.
3. "Weiner and Robin Matthews Environmental Engineering", Ruth F., Elesevier, 4th Edition, 2003.
4. "Air Pollution and Control", K. V. S. G. Murali Krishna, Kousal & Co. Publications, New Delhi.

Course Code	SMART GRID		L	T	P	C
21A020503			**3**	**0**	**0**	**3**
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- Impart knowledge on relevance smart grids technologies, its potential challenges and applications to the real world.
- Provide deeper insight on the customer's needs and consumption pattern for better load management and forecasting.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand the operational and functional aspects of smart grid, architecture and technical challenges. **(K2)**

CO2: Analyze the communication signals from various measuring units and sub-networks for monitoring secured operation adhering relevant standards. **(K4)**

CO3: Assess the various energy options and apply them for the sustainability of Smart grid. **(K2)**

CO4: Develop strategies for demand side management using various communication protocols. **(K3)**

CO5: Understand the challenges and relevant standards in interoperability and cyber security of Smart grid. **(K2)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction to Smart Grid: Introduction to smart grid as per National Institute Standards and Technology (NIST), smart grid architecture, functions of smart grid components, smart grid initiatives in India, technology drivers and challenges. Overview of the technologies required for smart grid and architecture of smart substation.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the basic concept of smart grid Technology. (L2)
- Explain Smart grid functions. (L3)
- Understand Smart grid architecture. (L2)

UNIT – II (9 Hrs)

Smart Grid Measurement Technology: Introduction, standards for information exchange, monitoring, smart meters, and measurement technologies, WAMS, PMUs, GIS and google mapping tools and multi-agent systems technology.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the measurement technologies. (L2)
- Explain the google mapping tools. (L3)
- Compare WAMS and PMU. (L3)

UNIT – III (9 Hrs)

Sustainable Energy Options for the Smart Grid: Renewable Energy Resources, Penetration and Variability Issues Associated with Sustainable Energy Technology, Demand Response Issues, Electric Vehicles and Plug-in Hybrids, Storage Technologies.

Learning Outcomes: At the end of the unit, the student will be able to

- Sketch the block diagram of Renewable energy source. (L3)
- Understand basic concept of Electric Vehicles. (L2)

UNIT – IV (9 Hrs)

Demand Side Management and Communication Technology: Introduction, Demand Side Management objectives and its classification. Communication technologies: IEEE 802X series. Layouts of Sub-networks: LAN, WAN, NAN, HAN and FAN and its comparison.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the basic concepts of management objectives. (L3)
- Compares the WAN, LAN, NAN, HAN. (L3)

UNIT – V (9 Hrs)

Interoperability, Standards and Cyber Security : Introduction, State-of-the-Art-Interoperability, Benefits and Challenges of Interoperability, Model for Interoperability in the Smart Grid Environment, Smart Grid Network Interoperability, Interoperability and Control of the Power Grid, Standards, Approach to Smart Grid Interoperability Standards, Smart Grid Cyber Security, Cyber Security State of the Art, Cyber Security Risks, cyber security concerns associated with Advanced Metering Infrastructure, Mitigation approach to cyber security risks.

Learning Outcomes: After successful completion of this unit, the students will be able to

- Understand basic Benefits and Challenges of Interoperability. (L2)
- Analyze Smart Grid Network Interoperability. (L4)

TEXTBOOKS:

1. “Smart Grid: Fundamentals of design and analysis”, James Momoh, John Wiley & sons Inc, IEEE press, 2012

2. "Smart Grid: Technology and Applications", Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, John Wiley & sons Inc., 2012.

REFERENCE BOOKS:

1. "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Fereidoon P. Shoshonis, Academic Press, 2012
2. "The smart grid: Enabling energy efficiency and demand response", Clark Grellings, Fairmont Press Inc, 2009.

ONLINE LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/107/108107113/
2. https://smartgrid.ieee.org/resources/webinars

Course Code	ENERGY STORAGE SYSTEMS		L	T	P	C
21A020504			**3**	**0**	**0**	**3**
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- Understand the need for energy storage
- Understand about the fundamentals of ESS
- Know about types, features and benefits of ESS
- Know about various management and control including market potential of ESS
- Study about various applications of ESS

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: To get exposed to latest technology of ESS. **(K3)**

CO2: Understand the principle, features, and benefits of ESS. **(K2)**

CO3: Understand the marketing and management strategies of ESS in working environment. **(K2)**

CO4: Distinguish wide variety of applications of EES for practical applications. **(K2)**

CO5: Know about latest technology applications of Battery SCADA, which is going to be vital in future applications, trend in new and renewable energy source. **(K4)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Fundamentals of ESS: Definitions, Characteristics of ESS, Electricity, and roles of ESSs, Emerging needs in ESS, Classification of ESSs, Roles of Electrical storage technologies.

Learning Outcomes: At the end of the unit, students should be able to

- To know about the fundamentals of ESS. (L4)
- To know about emerging needs and roles of ESS. (L4)
- To know about various classifications of ESS. (L4)
- To understand about roles of energy storage technologies. (L2)

UNIT – II (9 Hrs)

Types and Features of ESS Technologies: Mechanical storage systems, Electromechanical storage systems, Chemical energy storage, Electrical storage systems, Thermal storage systems, standards for EES, Comparison of ESS technology storage systems, Power and discharge duration, Energy and power density, Storage operating cost, Power quality, Reactive power capability.

Learning Outcomes: At the end of the unit, students should be able to

- To understand about various types of ESS technologies. (L2)
- To understand about standards for ESS. (L2)
- To learn about power and discharge duration of ESS. (L2)
- To know about preliminaries of ESS operating cost. (L4)
- To understand about power quality issues and reactive power capability of ESS. (L2)

UNIT – III (9 Hrs)

Storage Benefits: Definitions, Applications, specifications, benefits, Electric energy time shift, Electric supply capacity, reserve capacity, voltage support, Electric service power quality and reliability, Incidental benefits, energy losses, access charges, Risk, dynamic operating benefits, p.f. correction, reduced air emissions, flexibility, energy benefits.

Learning Outcomes: At the end of the unit, students should be able to

- To know various storage benefits. (L4)
- To distinguish between application specific benefits and identical benefits. (L2)
- To understand about electric service power quality and reliability issues. (L2)
- To learn about energy benefits from storage systems. (L3)

UNIT – IV (9 Hrs)

EES Market and Management: Utility and Consumer use, Measurement and Control hierarchy, Internal configurations, External connections, Battery SCADA, Market potential, estimation, role of aggregators, Maximum market potential estimates, Demand change management, Time-of-use energy cost management, storage modularity.

Learning Outcomes: At the end of the unit, students should be able to

- To understand about management of ESS technologies. (L2)
- To distinguish between internal and external configuration of ESS. (L2)
- To know about battery SCADA system and storage modularity. (L4)
- To distinguish between demand change and time-of-use energy cost management. (L2)

UNIT – V (9 Hrs)

Applications of EES: Power Vs Energy, Capacity Vs energy applications, specific power and discharge durations, Electric supply applications, ancillary service applications, End user/utility customer applications, Distributed energy storage applications, Locational, Non-locational and incidental applications.

Learning Outcomes: At the end of the unit, students should be able to

- To know about various ESS. (L4)
- To distinguish between power, capacity, energy applications of ESS. (L2)
- To distinguish between electric supply and ancillary applications. (L2)
- To understand about the importance of distributed energy storage applications. (L2)

TEXTBOOKS:

1. “Energy Storage Benefits and Market Analysis”, James M. Eyer, Joseph J. Iannucci and Garth P. Corey, Sandia National Laboratories, 2004
2. “The Electrical Energy Storage”, IEC Market Strategy Board, White paper.

REFERENCE BOOKS:

1. “Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide”, Jim Eyer, Garth Corey, Sandia National Laboratories”, Feb 2010.

Course Code	AUTOMATION IN INDUSTRIES		L	T	P	C
21A030503			3	0	0	3
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- Understand the need of automation
- Classify various types of automated transmission lines and components of automation.
- List and understand various material handling systems.
- Design various types of automated assembly systems
- Explain various automatic inspection systems.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand principles and basic elements of automation. **(K2)**
CO2: Understand the Detroit automation and automated flow lines. **(K2)**
CO3: Learn the material handling technology and assembly systems. **(K1)**
CO4: Learn the control systems technology and its process in automation. **(K1)**
CO5: Understand the inspection, testing and PLC's in automation. **(K2)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Production Economics: Methods of Evaluating Investment Alternatives, Costs in Manufacturing, Break- Even Analysis, Unit cost of production, Cost of Manufacturing Lead time and Work-in process.

***Learning Outcomes*:** At the end of this unit, students should be able to

- Understand the principles of production, investment, cost concepts in automation. (L2)

UNIT – II (10 Hrs)

Detroit-Type Automation: Automated Flow lines, Methods of Work-part Transport, Transfer Mechanism, Buffer Storage, Control Functions, and Automation for Machining Operations, Design and Fabrication Considerations.

Analysis of Automated Flow Lines: General Terminology and Analysis, Analysis of Transfer Lines Without Storage, Partial Automation, Automated Flow Lines with Storage Buffers, Computer Simulation of Automated Flow Lines.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the types of automation method concepts and machining operations. (L2)

UNIT – III (11 Hrs)

Material handling and Identification Technologies: The material handling function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. Automated Storage Systems: Storage System Performance, Automated Storage/Retrieval Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing. Product identification system: Barcode, RFID etc.

Automated Assembly Systems: Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multistation Assembly Machines, Analysis of a Single Station Assembly Machine.

***Learning Outcomes*:** At the end of this unit, students should be able to

- Apply the techniques of material handling and automated assembly systems. (L4)

UNIT – IV (7 Hrs)

Control Technologies in Automation: Industrial Control Systems, Process Industries Verses Discrete- Manufacturing Industries, Continuous Verses Discrete Control, Computer Process Control and its Forms. Computer Based Industrial Control: Introduction & Automatic Process Control, Building Blocks of Automation System: LAN, Analog & Digital I/O Modules, SCADA System & RTU.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the industrial control technologies in automation. (L2)

UNIT – V (8 Hrs)

Automated Inspection and Testing: Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods.

Programmable Logic Controllers (PLCs): Introduction, Micro PLC, Programming a PLC, Logic Functions, Input & Output Modules, PLC Processors, PLC Instructions, Documenting a PLC System, Timer & Counter Instructions, Typical PLC Programming Exercises for Industrial Applications.

***Learning Outcomes*:** At the end of this unit, students should be able to

- Explain the inspection, testing methods and PLC's methods in automation. (L2)

TEXTBOOKS:

1. "Automation, Production Systems and Computer Integrated Manufacturing", M. P. Grover, Pearson Education.

REFERENCE BOOKS:

1. "Computer Based Industrial Control", Krishna Kant, EEE-PHI
2. "Principles and Applications of PLC", Webb John, Mcmillan 1992
3. "An Introduction to Automated Process Planning Systems", Tiess Chiu Chang & Richard A. Wysk
4. "Anatomy of Automation", Amber G.H & P.S. Amber, Prentice Hall.

Course Code	RAPID PROTOTYPING		L	T	P	C
21A030504			3	0	0	3
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- The fundamental Theory behind RP process.
- Study the Process parameters of different machine.
- Study different types of Rapid tooling.
- Based on the industrial standards, learn how Prepare manufacturing DATA.
- The basics concept of different software used in RP system.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand Theory behind RP process. **(K2)**
CO2: Learn the Process parameters of different machine. **(K3)**
CO3: Learn different types of Rapid tooling. **(K3)**
CO4: Understand the industrial standards; learn how to prepare manufacturing Data. **(K2)**
CO5: Understand basics concept of different software used in RP system. **(K2)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction & History of Rapid Prototyping, Fundamentals of Rapid Prototyping, Advantages and Disadvantages of Rapid Prototyping, Applications of Rapid Prototyping, Classification of RP, Rapid prototyping process chain, Fundamental Automated processes.

Learning Outcomes**:** At the end of this unit, students should be able to

- Know about the importance of rapid prototyping. (L1)
- Understand the concept of Stereo lithography. (L2)

UNIT – II (9 Hrs)

Stereo lithography (SLA) system & principle, Process parameter, process details of SLA, Data preparation, data files of SLA, Machine details & Application of SLA.

Selective Laser Sintering (SLS)- Introduction, SLS Machine Type – Details, SLS principle of operation, Process parameters of SLS, Data preparation for SLS.

Learning Outcomes: At the end of this unit, students should be able to

- Illustrate about the selective laser sintering process. (L4)
- Explain about the concept of fused deposition modelling and solid ground curing. (L2)

UNIT – III (7 Hrs)

Fused Deposition Modeling (FDM) – Introduction, FDM Principles, Process Parameters, Path generation & Application of FDM, Solid Ground curing (SGC) - Principle of operation, SGC machine details & application. Laminate Object Manufacturing (LOM) - Principle of operation, LOM materials, LOM Process details & Application.

***Learning Outcomes*:** At the end of this unit, students should be able to

- Demonstrate about laminated object manufacturing process. (L2)
- Know about different 3D modelling printing techniques. (L1)

UNIT – IV (10 Hrs)

Rapid tooling -Indirect rapid tooling, Silicon Rubber tooling, Aluminium filling epoxy tooling, Spray metal tooling, Direct rapid tooling, Quick cast process, copper Polyamide, DMILS – explanation, Prometals, sand casting tooling, Soft tooling & hard tooling.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of rapid tolling. (L2)

UNIT – V (10 Hrs)

Rapid Manufacturing – Introduction, Factors influencing accuracy, Data preparation errors, Part building errors, Errors in finishing, Influence of build orientation.

***Learning Outcomes*:** At the end of this unit, students should be able to

- Understand different file format software’s of 3D modelling techniques. (L2)

TEXTBOOKS:

1. “Stereo lithography and other RP & M Technologies”, Paul F. Jacobs, SME, NY 1996.
2. “Rapid Manufacturing”, Flham D. T & Dinjoy S.S, Verlog London 2001.
3. “Rapid automated”, Lament wood, Indus press New York.

REFERENCE BOOKS:

1. “Wohler's Report 2000”, Terry Wohlers, Wohler's Association, 2000.
2. “Rapid prototyping materials”, Gurumurthi, IISc Bangalore

Course Code	JAVA PROGRAMMING		L	T	P	C
21A050503			3	0	0	3
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- Focus on object oriented concepts and java program structure and its installation.
- Comprehension of java programming constructs, control structures in Java.
- Implementing Object oriented constructs such as various class hierarchies, interfaces and exception handling.
- Understanding of Thread concepts and I/O in Java.
- Being able to build dynamic user interfaces using applets and Event handling in java.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Use of objects to program. **(K3)**
CO2: Create programs by using Java basic Constructs. **(K3)**
CO3: Implement OOPs concepts. **(K3)**
CO4: Develop JAVA applets applications. **(K4)**
CO5: Apply multi-threaded concepts in programming. **(K3)**

CO-PO MAPPING:

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

UNIT – I (8 Hrs)

Introduction to OOP: Introduction, Need of Object Oriented Programming, Principles of Object Oriented Languages, Procedural languages Vs OOP, Applications of OOP, History of JAVA, Java Virtual Machine, Java Features, Program structures, Installation of JDK1.6

Learning Outcomes: At the end of this unit, students should be able to

- Understand the syntax, semantics and features of Java Programming Language. (L1)
- Compare Object Oriented and Procedural Languages. (L4)

UNIT – II (9 Hrs)

Programming Constructs: Variables, Primitive Data types, Identifiers- Naming Coventions, Keywords, Literals, Operators-Binary, Unary and ternary, Expressions, Precedence rules and Associativity, Primitive Type Conversion and Casting, Flow of control- Branching, Conditional, loops. Classes and Objects- classes, Objects, Creating Objects, Methods, constructors-Constructor overloading, cleaning up unused objects-Garbage collector, Class variable and Methods-Static keyword, this keyword, Arrays, Command line arguments.

Learning Outcomes: At the end of this unit, students should be able to

- Developing simple programs with java constructs. (L5)
- Learning about various Keywords in Java and their uses. (L1)

UNIT – III (9 Hrs)

Inheritance: Types of Inheritance, Deriving classes using extends keyword, Method overloading, super keyword, final keyword, Abstract class. Interfaces, Packages and Enumeration: Interface-Extending interface, Interface Vs Abstract classes, Packages-Creating packages, using Packages, Access protection, java.lang package. Exceptions & Assertions – Introduction, Exception handling techniques- try catch, throw, throws, finally block, user defined exception.

Learning Outcomes: At the end of this unit, students should be able to

- Implement types of Inheritance and developing new classes based on existing classes. (L4)
- Distinguish between system packages and user defined packages. (L4)
- Demonstrate features of interfaces to implement multiple inheritances. (L3)
- Applying Exception in Programs where necessary. (L4)

UNIT – IV (6 Hrs)

Multi Threading: java.lang.Thread, The main Thread, Creation of new threads, Thread priority, Multithreading-Synchronization, suspending and Resuming threads, Communication between Threads Input / Output: reading and writing data, java.io package

Learning Outcomes: At the end of this unit, students should be able to

- Understand concurrency, parallelism and multithreading. (L2)
- Create multitasking applications. (L5)

UNIT – V (9 Hrs)

Applets– Applet class, Applet structure, An Example Applet Program, Applet : Life Cycle, paint(), update() and repaint() Event Handling -Introduction, Event Delegation Model, java.awt. event Description, Sources of Events, Event Listeners, Adapter classes, Inner classes.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the GUI programming. (L2)
- Perform event Handling in java GUI Programs. (L5)

TEXTBOOKS:

1. “The Complete Reference Java”, Herbert Schildt, TMH, 8th Edition
2. “Programming in JAVA”, Sachin Malhotra, Saurabh choudhary, Oxford.
3. “JAVA for Beginners”, Joyce Farrell, Ankit R. Bhavsar, Cengage Learning, 4th Edition.

4. "Object oriented programming with JAVA, Essentials and Applications", Raj Kumar Bhuyya, Selvi, Chu TMH.
5. "Introduction to Java Programming", Y Daniel Liang, Pearson, 7th Edition.

REFERENCE BOOKS:

1. "JAVA Programming", K. Rajkumar. Pearson.
2. "Core JAVA, Black Book", Nageswara Rao, Wiley, Dream Tech
3. "Core JAVA for Beginners", Rashmi Kanta Das, Vikas.
4. "Object Oriented Programming through JAVA", P Radha Krishna, University Press.

ONLINE LEARNING RESOURCES:

1. https://www.w3schools.com/java/
2. https://www.javatpoint.com/java-tutorial

Course Code	BASICS OF DATABASE MANAGEMENT SYSTEMS		L	T	P	C
21A050504			3	0	0	3
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- Provides students with theoretical knowledge and practical skills in the use of databases.
- Database management systems in information technology applications.
- The logical design, physical design and implementation of relational databases are covered.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Define a Database Management System. **(K2)**
CO2: Compare the advantages and disadvantages of the different models. **(K4)**
CO3: Design Database using E-R Diagram (SQL). **(K4)**
CO4: Analyze the rules guiding transaction ACID properties. **(K4)**
CO5: Analyze file organization while storing and retrieving the data base **(K4)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

INTRODUCTION: Database system, Characteristics (Database Vs File System), Database Users (Actors on Scene, Workers behind the scene), Advantages of Data base systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

Learning Outcomes: At the end of this unit, students should be able to

- Distinguish between Database and File System. (L4)
- Categorize different kinds of data models. (L4)
- Define functional components of DBMS. (L2)

UNIT – II (8 Hrs)

RELATIONAL MODEL: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance **BASIC SQL:** Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update), basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions(Date and Time, Numeric, String conversion).

Learning Outcomes: At the end of this unit, students should be able to

- Outline the elements of the relational model such as domain, attribute, tuple, relation and entity. (L2)
- Distinguish between various kinds of constraints like domain, key and integrity. (L4)
- Define relational schema Develop queries using Relational Algebra and SQL. (L2)
- Perform DML operations on databases. (L4)

UNIT – III (8 Hrs)

ENTITY RELATION MODEL: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams. **SQL:** Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view (updatable and non-updatable), relational set operations.

Learning Outcomes: At the end of this unit, students should be able to

- Develop E-R model for the given problem. (L4)
- Derive tables from E-R diagrams. (L4)

UNIT – IV (8 Hrs)

TRANSACTION MANAGEMENT AND CONCURRENCY CONTROL: Transaction, properties of transactions, transaction log, and transaction management with SQL using commit rollback and save point. Concurrency control for lost updates, uncommitted data, inconsistent retrievals and the Scheduler. Concurrency control with locking methods: lock types, two phase locking for ensuring serializability, deadlocks, Concurrency control with time stamp ordering : Wait/Die and Wound/Wait Schemes, Database Recovery management : Transaction recovery. SQL constructs that grant access or revoke access from user or user groups. Basic PL/SQL procedures, functions and triggers.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various properties of transaction. (L1)
- Design atomic transactions for an application. (L4)
- Gain the knowledge about log mechanism and check pointing techniques for system recovery. (L2)
- Create PLSQL programs and triggers for different database conditions. (L5)

UNIT – V (9 Hrs)

STORAGE AND INDEXING: Database file organization, file organization on disk, heap files and sorted files, hashing, single and multi-level indexes, dynamic multilevel indexing using B-Tree and B+ tree, index on multiple keys.

Learning Outcomes: At the end of this unit, students should be able to

- Understand file organization (L2)
- Compare various indexing techniques (L4)

TEXTBOOKS:

1. "Database Management Systems", Raghuram Krishnan, Johannes Gehrke, TMH, 3rd Edition
2. "Database Management System", Ramez Elmasri, Shamkant B. Navathe, PEA, 6th Edition
3. "Database Principles Fundamentals of Design Implementation and Management", Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

REFERENCE BOOKS:

1. "Database System Concepts", Silberschatz, Korth, TMH, 5th Edition
2. "Introduction to Database Systems", C J Date, PEA, 8th Edition

WEBLINKS

1. https://www.javatpoint.com/dbms-tutorial
2. https://www.geeksforgeeks.org/dbms/

OPEN ELECTIVE – III

Course Code	DISASTER MANAGEMENT AND MITIGATION		L	T	P	C
21A010503			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To obtain the basic knowledge of Environmental Hazards and disasters.
- To understand the basics of Endogenous and Exogenous hazards and gives a suitable picture on the different types of hazard and disaster mitigation methods.
- To understand the key concepts of disaster management related to development and the relationship of different disaster management activities.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Analyze and evaluate the environmental, social, cultural, economic, legal and organizational Aspects influencing vulnerabilities and capacities to face disasters and to know about different types of environmental hazards. **(K4)**

CO2: Compute knowledge on different types of natural and man- made disasters. Work theoretically and practically in the processes of disaster management (disaster risk reduction, response, and recovery). **(K3)**

CO3: Develop an awareness of the chronological phases of natural disaster response and refugee relief operations. Understand how the phases of each are parallel and how they differ. **(K3)**

CO4: Identify endogenous and exogenous hazards their harmful effects to the environment, Case studies of India. **(K1)**

CO5: Identify the regulatory controls used in hazard management. **(K1)**

CO-PO MAPPING:

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

UNIT – I (8 Hrs)

Environmental Hazards & Disasters: Meaning of Environmental hazards, Environmental Disasters and Environmental stress. Concept of Environmental Hazards, Environmental stress & Environmental Disasters. Different approaches & relation with human Ecology - Landscape Approach - Ecosystem Approach - Perception approach - Human ecology & its application in geographical researches.

Learning Outcomes: At the end of this unit, students should be able to

- Debate on the Knowledge of the disaster phenomenon, its different contextual aspects, impacts and public health consequences. (L5)

- Express about the natural hazards and its management. (L6)

UNIT – II (10 Hrs)

Types of Environmental hazards & Disasters: Natural hazards and Disasters - Man induced hazards & Disasters - Natural Hazards- Planetary Hazards/ Disasters - Extra Planetary Hazards/ disasters - Planetary Hazards- Endogenous Hazards - Exogenous Hazards

Learning Outcomes: At the end of this unit, students should be able to

- Explain the Capacity to manage the Public Health aspects of the disasters. (L4)
- Distinguish the different types of environmental hazards & disasters. (L5)

UNIT – III (9 Hrs)

Risk and Vulnerability: Building codes and land use planning – social vulnerability – environmental vulnerability – Macroeconomic management and sustainable development, climate change risk rendition – financial management of disaster – related losses.

Learning Outcomes: At the end of this unit, students should be able to

- Explain about the regulations of building codes and land use planning related to risk and vulnerability. (L4)
- Justify the financial management of disaster and related losses. (L6)

UNIT – IV (9 Hrs)

Exogenous hazards/ disasters - Infrequent events- Cumulative atmospheric hazards/ disasters Infrequent events: Cyclones – Lightning – Hailstorms Cyclones: Tropical cyclones & Local storms - Destruction by tropical cyclones & local storms (causes , distribution human adjustment, perception & mitigation)Cumulative atmospheric hazards/ disasters : - Floods- Droughts- Cold waves- Heat waves. Floods:- Causes of floods- Flood hazards India- Flood control measures (Human adjustment, perception & mitigation).Droughts:- Impacts of droughts- Drought hazards in India- Drought control measures.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the Mitigation and control measures of exogenous hazards. (L2)
- Analyze, and communicate information on risks, relief needs and order to formulate strategies for mitigation. (L4)

UNIT – V (9 Hrs)

Soil Erosion: - Mechanics & forms of Soil Erosion- Factors & causes of Soil Erosion- Conservation measures of Soil Erosion. Chemical hazards/ disasters:-- Release of toxic chemicals, nuclear explosion- Sedimentation processes. Sedimentation processes:- Global Sedimentation problems- Regional Sedimentation problems- Sedimentation & Environmental problems- Corrective measures of Erosion & Sedimentation. Biological hazards/ disasters:- Population

Explosion.

Learning Outcomes: At the end of this unit, students should be able to

- Relate their interconnections, particularly in the field of the Public Health aspects of the disasters. (L3)
- Understand different approaches to prevent disasters. (L2)

TEXTBOOKS:

1. "Disaster Management", Rajib Shah, Universities Press, India, 2003
2. "Disaster Science and Management", Tushar Bhattacharya, TMH Publications.
3. "Disaster Mitigation: Experiences and Reflections", Pardeep Sahni
4. "Natural Hazards & Disasters", Donald Hyndman & David Hyndman, Cengage Learning.

REFERENCE BOOKS:

1. "The Environment as Hazards", Kates, B.I & White, G.F, Oxford Publishers, New York, 1978
2. "Disaster Management", R.B. Singh (Ed), Rawat Publication, New Delhi, 2000
3. "Disaster Management", H.K. Gupta (Ed), Universities Press, India, 2003
4. "Space Technology for Disaster Mitigation in India (INCED)", R.B. Singh, University of Tokyo, 1994.

ONLINE LEARNING RESOURCES:

1. http://ndma.gov.in
2. http://www.ndrf.gov.in

Course Code	RENEWABLE ENERGY SYSTEMS		L	T	P	C
21A020505			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- Understand various sources of Energy and the need of Renewable Energy Systems.
- Understand the concepts of Solar Radiation, Wind energy and its applications.
- Analyze solar thermal and solar PV systems
- Understand the concept of geothermal energy and its applications, biomass energy, the concept of Ocean energy and fuel cells.

COURSE OUTCOMES:

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

CO1: Understand various alternate sources of energy for different suitable application requirements. **(K2)**

CO2: Understand the concepts of solar energy generation strategies and wind energy system. **(K2)**

CO3: Analyze Solar and Wind energy systems. **(K4)**

CO4: Understand the basics of Geothermal Energy Systems, various diversified energy scenarios of ocean, biomass, and fuel cells. **(K2)**

CO5: Understand the fundamentals of Solar and Wind energy systems. **(K2)**

CO-POMAPPING:

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

UNIT – I (9 Hrs)

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, sunset and day length. Flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.

Learning Outcomes: At the end of the unit, students should be able to

- Understanding renewable and nonrenewable energy resources. (L2)
- Understand the various forms of conventional energy resources. (L2)
- Understanding of Solar power properties. (L2)

UNIT – II (8 Hrs)

PV Energy Systems: Introduction, The PV effect in crystalline silicon basic principles, the film

PV, Other PV technologies, Electrical characteristics of silicon PV cells and modules, PV systems for remote power, Grid connected PV systems.

Learning Outcomes: At the end of the unit, students should be able to

- Understand the PV cells and modules. (L2)
- Disseminate information on PV. (L3)

UNIT – III (10 Hrs)

Wind Energy: Principle of wind energy conversion; Basic components of wind energy conversion systems; windmill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.

Learning Outcomes: At the end of the unit, students should be able to

- Understanding of wind energy production. (L2)
- Outline division aspects and utilization of renewable energy sources for both domestics and industrial application. (L3)
- Understand the need of Wind Energy and the various components used in energy generation and know the classification. (L2)

UNIT – IV (8 Hrs)

Geothermal Energy: Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

Learning Outcomes: At the end of the unit, students should be able to

- Identify the Resources of geothermal energy.(L2)

UNIT – V (10 Hrs)

Miscellaneous Energy Technologies: Ocean Energy: Tidal Energy-Principle of working, performance and limitations. Wave Energy-Principle of working, performance and limitations. Bio mass Energy: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration

Fuel cell: Principle of working of various types of fuel cells and their working, performance and limitations.

Learning Outcomes: At the end of the unit, students should be able to

- Understand the concept of Biomass energy resources and their classification. (L2)
- Analyze the performance of Ocean Energy. (L4)

TEXTBOOKS:

1. "Renewable Energy Power for a Sustainable Future", Stephen Peake, Oxford International

Edition, 2018.
2. "Non-Conventional Energy Sources", G. D. Rai, Khanna Publishers, 4th Edition, 2000.

REFERENCE BOOKS:

1. "Solar Energy", S. P. Sukhatme, Tata Mc Graw Hill Education Pvt. Ltd, 3rd Edition, 2008.
2. "Non-Conventional Energy Resources", B H Khan, Tata Mc Graw Hill Education Pvt Ltd, 2nd Edition, 2011.
3. "Non-Conventional Energy Resources", S. Hasan Saeed and D. K. Sharma, S. K. Kataria & Sons, 3rd Edition, 2012
4. "Renewable Energy Resource: Basic Principles and Applications", G. N. Tiwari and M. K. Ghosal, Narosa Publishing House, 2004

ONLINE LEARNING RESOURCES:

1. https://nptel.ac.in/courses/103103206
2. https://nptel.ac.in/courses/108108078

Course Code	CONCEPTS OF ELECTRICAL DRIVES AND APPLICATIONS		L	T	P	C
21A020506			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- The operation of electric motor drives controlled by power electronic converters.
- The stable steady-state operation and transient dynamics of a motor-load system.
- The operation of the chopper fed DC drive.
- The distinguishing features of synchronous motor drives and induction motor drives.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Identify the choice of the electric drive system based on their applications. **(K2)**

CO2: Explain the operation of single and multi-quadrant electric drive. **(K3)**

CO3: Analyze single phase and 3-phase rectifiers fed DC motors and chopper fed DC motors. **(K4)**

CO4: Explain the speed control methods for AC-AC & DC-AC converters fed to Induction motors with closed loop, and open loop operations. **(K3)**

CO5: Explain the speed control methods for AC-AC & DC-AC converters fed to Synchronous motors with closed loop, and open loop operations. **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Converter Fed DC Motors: Classification of Electric Drives, Basic elements of Electric Drive, Dynamic Control of a Drive system, Stability analysis, Introduction to Thyristor Controlled Drives, Single Phase semi and fully controlled converters connected to D.C Separately Excited and D.C Series Motors – Continuous Current Operation – Output Voltage and Current Waveforms – Speed and Torque Expressions – Speed – Torque Characteristics.

Learning Outcomes: At the end of the unit, students should be able to

- Understand the basic electrical drive elements and its function. (L2)
- Analyze the single-phase dc drives and its speed-torque characteristics. (L4)
- Analyze the three phase dc drives and its speed-torque characteristics (L4)

UNIT – II (9 Hrs)

Four Quadrant Operation of DC Drives: Introduction to Four Quadrant Operation – Motoring

Operations, Electric Braking – Plugging, Dynamic and Regenerative Braking Operations. Four Quadrant Operation of D.C Motors by Dual Converters – Closed Loop Operation of DC Motor (Block Diagram Only).

Learning Outcomes: At the end of the unit, students should be able to

- Understand the four-quadrant operation of the dc drives. (L2)
- Analyze the various motoring and braking operations of the dc motors. (L4)
- Understand the closed loop operation of the dc drives. (L2)

UNIT – III (9 Hrs)

Chopper fed DC Motors: Single Quadrant, Two Quadrant and Four Quadrant Chopper Fed DC Separately Excited and Series Excited Motors – Continuous Current Operation – Output Voltage and Current Wave Forms – Speed Torque Expressions – Speed Torque Characteristics– Problems on Chopper Fed D.C Motors.

Learning Outcomes: At the end of the unit, students should be able to

- Understand the basics concepts of choppers and its operation. (L2)
- Analyze the classification of various choppers feeding the dc drives. (L4)

UNIT – IV (9 Hrs)

Control of Induction Motor: Induction Motor Stator Voltage Control and Characteristics. AC Voltage Controllers–Waveforms – Speed Torque Characteristics - Stator Frequency Control and characteristics. Voltage Source and Current Source Inverter – Comparison of VSI and CSI Operations – Speed Torque Characteristics – Static Rotor Resistance Control

Learning Outcomes: At the end of the unit, students should be able to

- Understand the various speed control methods of induction motor used in drives. (L2)
- Analyze the voltage source and current source inverters used in AC drives. (L4)
- Apply the various speed control methods to induction motor on rotor side. (L3)

UNIT – V (9 Hrs)

Control of Synchronous Motors: Separate Control & Self Control of Synchronous Motors – Operation of Self-Controlled Synchronous Motors by VSI and CSI. Load Commutated CSI Fed Synchronous Motor – Operation – Waveforms – Speed Torque Characteristics – Applications – Advantages.

Learning Outcomes: At the end of the unit, students should be able to

- Understand the self and separate control methods of synchronous motor drives. (L2)
- Analyze the voltage source and current source inverters used in AC drives. (L4)
- Apply the various speed control methods of synchronous motors. (L4)

TEXTBOOKS:

1. “Power semiconductor-controlled drives”, G K Dubey, Prentice Hall, 1995.

2. "Modern Power Electronics and AC Drives", B. K. Bose, PHI, 2002.

REFERENCE BOOKS:

1. "Power Electronics", MD Singh and K B Khanchandani, Tata McGraw-Hill Publishing company, 2008.
2. "Power Electronic Circuits, Devices and applications", M. H. Rashid, PHI, 2005.
3. "Electric drives Concepts and Applications", Vedam Subramanyam, Tata McGraw Hill Publications, 2nd Edition, 2011.

Course Code	OPTIMIZATION TECHNIQUES		L	T	P	C
21A030505			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To introduce the basic fundamentals of optimization methods that can be used during a design process.
- To expose the students to different modern optimization techniques.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand basic theoretical principles of optimization models and its solution. **(K2)**
CO2: Formulate the given practical problem and solving by graphical /simplex method. **(K3)**
CO3: Analyse the cost for transportation and assigning the jobs to machines. **(K3)**
CO4: Analyse the cost and duration of the project, also preparation of job scheduling. **(K3)**
CO5: Use latest methods for optimization. **(K2)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Introduction to Optimization: Classification of Optimization, Design vector and constraints, Constraint surface, Objective function, Classification of Optimization Problems.

Classical Optimization Techniques: Single variable optimization, Multi-variable: Direct substitution method, Lagrange's method of multipliers, Karush-Kuhn-Tucker conditions

Learning Outcomes: At the end of this unit, students should be able to

- Explain how to formulate statement of optimization problem with or without constraints. (L3)
- Explain about classification of single and multivariable optimization problems. (L3)
- Know about necessary and sufficient conditions in defining the optimization problems. (L1)
- Understand how to formulate Kuhn-Tucker conditions and to solve numerical problems. (L3)

UNIT – II (8 Hrs)

Linear Programming: Statement of an LP problem, Graphical Solution of an LP problem, Simplex method, Two phase method, Dual simplex method.

Learning Outcomes: At the end of this unit, students should be able to

- Formulation of problem as LPP. (L4)
- Solve numerical problems with graphical method, Simplex method, two phase method and dual simplex method. (L4)

UNIT – III (9 Hrs)

Transportation Problems: Introduction, Optimal Solution for BFS, Unbalanced Transportation Problem, Transshipment, Assignment Problems, Hungarian Method.

***Learning Outcomes*:** At the end of this unit, students should be able to

- Model linear programming problems like the transportation. (L6)
- Solve the problems of transportation from origins to destinations with minimum time and cost. (L3)
- Solve assignment problems. (L4)

UNIT – IV (10 Hrs)

Project Management: Introduction, Critical Path Method, Critical Path Determination, Optimal Scheduling by CPM, Project Evaluation and Review Technique.

Sequencing: Introduction to Job shop Scheduling and flow shop scheduling, Solution of Sequencing Problem, Processing of n Jobs through two machines, Processing of n Jobs through m machines, graphical method.

Learning Outcomes: At the end of this unit, students should be able to

- Represent any project in the form of a network and estimate the parameters like Project Completion Time, Project Costs, and Optimum Duration of the Project. (L4)
- Probabilities of completing Projects as per schedule etc by applying either CPM or PERT technique as per the suitability. (L4)
- Solve problems of production scheduling. (L3)

UNIT – V (8 Hrs)

Modern Methods of Optimization: An overview of evolutionary algorithms, Genetic algorithms, simulated annealing, fuzzy optimization, neural-network based methods, Particle swarm optimization.

***Learning Outcomes*:** At the end of this unit, students should be able to

- Solve the numerical problems using modern optimization techniques. (L4)

TEXTBOOKS:

1. "Engineering Optimization- Methods and Applications", A. Ravindran, K. M. Ragsdell, G.V. Reklaitis, Wiley India Edition, 2nd Edition.
2. "Operations Research: An Introduction", H.A. Taha, PHI Pvt. Ltd., 6th Edition

REFERENCE BOOKS:

1. "Introduction to Optimum Design", J S Arora, Mc-Graw Hill.
2. "Optimization Methods for Engineering Design", Fox, R. L., Addison Wesley, 2001.
3. "Multi-objective optimization using evolutionary algorithms", K Deb John Wiley Publications.
4. "Operations Research", Dr. J. K. Sharma, Mc Millan.
5. "Engineering Optimization: Theory and Practice", Singiresu S. Rao, John Wiley & Sons

Course Code	GLOBAL WARMING AND CLIMATE CHANGES		L	T	P	C
21A030506			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To know the basics, importance of global warming.
- To know the concepts of mitigation measures against global warming
- To know the impacts of climate changes

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Know the impact of Ozone layer on green house effect and global warming. **(K1)**
CO2: Understand the structure of atmosphere and effects of inversion on pollution dispersion. **(K2)**
CO3: Know the effect of global warming and climatic changes on environment. **(K1)**
CO4: Understand Global change in temperature and climate and measures to reduce the effect. **(K2)**
CO5: Understand the clean technology, use of renewable energy, mitigation technologies and their practices **(K2)**

CO-PO MAPPING:

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

UNIT – I (7 Hrs)

EARTH'S CLIMATE SYSTEM:

Introduction to environment, Ozone, ozone layer and its functions, Ozone depletion and ozone hole, Vienna convention and Montreal protocol, Green house gases and green house effect, Hydrological cycle and Carbon cycle, Global warming and its impacts

Learning Outcomes: At the end of this unit, students should be able to

- Identity the importance of Ozone and effect of green house gases. (L1)
- Know the effect of global warming. (L1)

UNIT – II (9 Hrs)

ATMOSPHERE & ITS COMPONENTS: Atmosphere and its layers-Characteristics of Atmosphere - Structure of Atmosphere - Composition of Atmosphere - Atmospheric stability - Temperature profile of the atmosphere - Temperature inversion and effects of inversion on pollution dispersion.

Learning Outcomes: At the end of this unit, students should be able to

- Know about the layers of atmosphere and their characteristics. (L1)

UNIT – III (8 Hrs)

IMPACTS OF CLIMATE CHANGE: Causes of Climate change - Change of Temperature in the environment - Melting of ice and sea level rise - Impacts of Climate Change on various sectors - Projected impacts for different regions, uncertainties in the projected impacts and risk of irreversible changes.

Learning Outcomes: At the end of this unit, students should be able to

- Know about the causes of climate change and its effects on various sectors. (L1)

UNIT – IV (10 Hrs)

OBSERVED CHANGES AND ITS CAUSES: Climate change and Carbon credits-Clean Development Mechanism (CDM), CDM in India - Kyoto Protocol - Intergovernmental Panel on Climate Change (IPCC) - Climate Sensitivity - Montreal Protocol - United Nations Framework Convention on Climate Change (UNFCCC) - Global change in temperature and climate and changes within India

Learning Outcomes: At the end of this unit, students should be able to

- Know about the causes of climate change and carbon credits, effect of change in temperature and climate on India. (L1)

UNIT – V (11 Hrs)

CLIMATE CHANGE AND MITIGATION MEASURES: CDM and Carbon Trading - Clean Technology, biodiesel, compost, biodegradable plastics - Renewable energy usage as an alternative - Mitigation Technologies and Practices within India and around the world - Non-renewable energy supply to all sectors - Carbon sequestration - International and regional cooperation for waste disposal biomedical wastes, hazardous wastes, e-wastes, industrial wastes, etc.,

Learning Outcomes: At the end of this unit, students should be able to

- Know about the clean technology, use of renewable energy, mitigation technologies and their practices. (L1)

TEXTBOOKS:

1. “Climate Change – An Indian Perspective”, Dash Sushil Kumar, Cambridge University Press India Private limited 2007.

REFERENCE BOOKS:

1. “Adaptation and mitigation of climate change-Scientific Technical Analysis”, Cambridge University Press, Cambridge, 2006.
2. “Atmospheric Science”, J.M. Wallace and P.V. Hobbs, Elsevier / Academic Press 2006.

3. "Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Jan C. van Dam, Cambridge university press, 2003.
4. "Global Warming: Understanding the Forecast"", David Archer, Wiley, 2nd Edition, 2011
5. "Global Warming: The Complete Briefing", John Houghton, Cambridge University Press, 5th Edition, 2015

Course Code	INTRODUCTION TO INTERNET OF THINGS		L	T	P	C
21A050505			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To understand Smart Objects and IoT Architectures.
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications.

COURSE OUTCOMES:

At the end of the unit, students will be able to:

CO1: Analyze various protocols for IoT. **(K4)**
CO2: Design a PoC of an IoT system using Raspberry Pi/Arduino. **(K3)**
CO3: Apply data analytics and use cloud offerings related to IoT. **(K3)**
CO4: Analyze applications of IoT in real time scenario. **(K4)**
CO5: Analyze applications of IoT in real time Applications. **(K4)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

FUNDAMENTALS OF IoT: Evolution of Internet of Things, Enabling Technologies, IoT Architectures,oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

Learning Outcomes: At the end of this unit, students should be able to

- Explain IoT architecture. (L2)
- Interpret the design principles that govern connected devices. (L2)
- Summarize the roles of various organizations for IoT. (L2)
- Interpret the significance of Prototyping. (L2)

UNIT – II (10 Hrs)

IoT PROTOCOLS: IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the basics of microcontrollers. (L2)
- Outline the architecture of Arduino. (L2)
- Develop simple applications using Arduino. (L3)
- Outline the architecture of Raspberry Pi. (L2)
- Develop simple applications using Raspberry Pi. (L3)
- Select a platform for a particular embedded computing application. (L3)

UNIT – III (8 Hrs)

DESIGN AND DEVELOPMENT: Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.

Learning Outcomes: At the end of this unit, students should be able to

- Interpret different protocols and compare them. (L2)
- Select which protocol can be used for a specific application. (L3)
- Utilize the Internet communication protocols for IoT applications. (L3)
- Select IoT APIs for an application. (L3)
- Design and develop a solution for a given application using APIs. (L6)
- Test for errors in the application. (L4)

UNIT – IV (8 Hrs)

DATA ANALYTICS AND SUPPORTING SERVICES: Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning – No SQL Databases, Hadoop Ecosystem, Apache Kafka, Apache Spark, Edge Streaming Analytics and Network Analytics, Xively Cloud for IoT, Python Web Application Framework, Django, AWS for IoT, System Management with NETCONF-YANG.

Learning Outcomes: At the end of this unit, students should be able to

- Plan the business model. (L6)
- Predict the market value. (L6)
- Build the product. (L6)

UNIT – V (9 Hrs)

CASE STUDIES/INDUSTRIAL APPLICATIONS: Cisco IoT system, IBM Watson IoT platform, Manufacturing, Converged Plant wide Ethernet Model (CPwE), Power Utility Industry, Grid Blocks Reference Model, Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

Learning Outcomes: At the end of this unit, students should be able to

- Outline the manufacturing techniques. (L2)
- Adapt the Ethics of the IoT. (L6)

TEXTBOOKS:

1. "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017.

REFERENCE BOOKS:

1. "Database System Concepts", Silberschatz, Korth, TMH, 5th Edition
2. "Introduction to Database Systems", C J Date, PEA, 8th Edition
3. "The Database book principles & practice using Oracle/MySql", Narain Gehani, University Press.

ONLINE LEARNING RESOURCES:

1. https://en.wikipedia.org/wiki/Cloud_computing
2. https://www.infoworld.com/article/2683784/what-is-cloud-computing.html

Course Code	WEB TECHNOLOGIES FOR BEGINNERS		L	T	P	C
21A050506			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- This course is designed to introduce students with no programming experience to the programming languages
- Techniques associated with the World Wide Web.
- The course will introduce web-based media-rich programming tools for creating interactive web pages.

COURSE OUTCOMES:

After completing the course student will be able to

CO1: Analyze a web page and identify its elements and attributes. **(K4)**
CO2: Create web pages using XHTML and Cascading Styles sheets. **(K5)**
CO3: Build dynamic web pages. **(K5)**
CO4: Build web applications using PHP. **(K5)**
CO5: Programming through PERL and Ruby, client-side scripts using AJAX **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

HTML tags, Lists, Tables, Images, forms, Frames. Cascading style sheets. Introduction to Java script. Objects in Java Script. Dynamic HTML with Java Script

Learning Outcomes: At the end of this unit, students should be able to

- Create standard tags of HTML tags and Knowing the features of designing static web pages. (L6)
- List different types of CSS to design webpage attractively. (L1)
- Apply Java script concepts and create dynamic HTML pages. (L4)

UNIT – II (10 Hrs)

Working with XML: Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX.

Learning Outcomes: At the end of this unit, students should be able to

- Understand how XML interacts with different applications. (L1)
- Examine background applications using XSL and XSLT. (L4)

<u>UNIT – III</u> (9 Hrs)

AJAX A New Approach: Introduction to AJAX, Integrating PHP and AJAX. Consuming WEB services in AJAX: (SOAP, WSDL, UDDI)

Learning Outcomes: At the end of this unit, students should be able to

- Explain the importance of AJAX Architecture. (L2)
- Integrate and test web services. (L5)

<u>UNIT – IV</u> (9 Hrs)

PHP Programming: Introducing PHP: Creating PHP script, Running PHP script. Working with variables and constants: Using variables, Using constants, Data types, Operators. Controlling program flow: Conditional statements, Control statements, Arrays, functions. Working with forms and Database such as my Sql.

Learning Outcomes: At the end of this unit, students should be able to

- Develop PHP Programs using WAMP and XAMPP Server. (L3)
- Create a website with a Database (My SQL) in PHP. (L5)

<u>UNIT – V</u> (8 Hrs)

Introduction to PERL, Perl language elements, Interface with CGI- A form to mail program, Simple page search

Learning Outcomes: At the end of this unit, students should be able to

- Creating simple programs with PERL. (L4)
- Comparing CGI with other server-side technologies. (L5)

<u>TEXTBOOKS:</u>

1. "Programming the World Wide Web", Robert W Sebesta, Pearson Education, 7th Edition
2. "Web Technologies", Uttam K Roy, Oxford University Press
3. "The Web Warrior Guide to Web Programming", Bai, Ekedahl, Farrelll, Gosselin, Zak, Karparhi, Maclntyre, Morrissey, Cengage Learning

<u>REFERENCE BOOKS:</u>

1. "Ruby on Rails Up and Running, Lightning fast Web development", Bruce Tate, Curt Hibbs, Oreilly Media Inc., 2006

2. "Programming Perl", Tom Christiansen, Jonathan Orwant, Oreilly Media Inc., 4th Edition, 2012
3. "Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX", Black book, Dream Tech.
4. "An Introduction to Web Design, Programming", Paul S Wang, Sanda S Katila, Cengage Learning.

ONLINE LEARNING RESOURCES:

1. https://www.w3schools.com/html/
2. https://www.w3schools.com/js/
3. https://www.w3schools.com/xml/xml_whatis.asp
4. https://www.w3schools.com/php/

OPEN ELECTIVE – IV

Course Code	COST EFFECTIVE HOUSING TECHNIQUES		L	T	P	C
21A010504			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To train the students to have a comprehensive knowledge of planning, design, evaluation, construction
- To train the students to financing of housing projects
- To Provide Knowledge on cost effective construction materials and methods.
- To teach the principles of sustainable housing policies and programmes.

COURSE OUTCOMES:

At the end of the course, student will be able to

CO1: Understand about planning, design, evaluation, construction and financing of housing projects with cost effective housing techniques. **(K2)**

CO2: Choose the basic housing programmes and services and slum improvement and relocation. **(K3)**

CO3: The student can be in a position to adopt the suitable techniques in construction of low cost constructions. **(K6)**

CO4: Understand about alternate building materials for low cost housing techniques and sanitation services in rural areas. **(K2)**

CO5: The student can be in a position to analyze the suitable techniques in rural and disaster prone areas by using locally available materials. **(K4)**

CO-PO MAPPING:

	PO1	PO2	PO2	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	2	-	-	-	-	-	-	2	2
CO2	2	2	2	-	-	2	2	-	-	-	-	-	2	2
CO2	2	2	2	-	-	2	2	-	-	-	-	-	2	2
CO4	2	2	2	2	-	2	-	-	-	-	-	-	2	2
CO5	2	2	2	2	-	2	2	-	-	-	-	-	2	2

UNIT – I (9 Hrs)

INTRODUCTION TO HOUSING: Definition of Basic Terms – House, Home, Household, Apartments, Multi storied Buildings, Special Buildings, Objectives and Strategies of National Housing Policies including Slum Housing Policy, Principle of Sustainable Housing – Integrated approach on arriving holding capacity and density norms - All basic infrastructure consideration - Institutions for Housing at National, State and Local levels.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the about basics about housing norms. (L4)
- Understand the objectives and strategies of housing policies. (L2)

UNIT – II (9 Hrs)

HOUSING PROGRAMMES: Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighborhoods- Plotted land development programs, Open Development Plots, Apartments, Gated communities, Townships, Rental Housing, Co-operative Housing, Slum Housing Programmes – Slum improvement – Slum redevelopment and Relocation – Use of GIS and MIS in Slum Housing Projects,, Role of Public housing agencies, and Private sector in supply, quality, infrastructure and pricing – Role of Non-Government Organizations in slum housing.

Learning Outcomes: At the end of this unit, students should be able to

- Differentiate the usage of GIS and MIS in housing projects. (L4)
- Explain about development of plots and gated communities. (L4)

UNIT – III (9 Hrs)

DEVELOPMENT AND ADOPTION OF LOW COST HOUSING TECHNOLOGY: Introduction - Adoption of innovative cost effective construction techniques - Adoption of precast elements - Adopting of total prefabrication of mass housing in India- General remarks on pre cast rooting/flooring systems -Economical wall system - Single Brick thick loading bearing wall - 19cm thick load bearing masonry walls - Half brick thick load bearing wall - Fly ash gypsum thick for masonry - Stone Block masonry - Adoption of precast R.C. plank and join system for roof/floor in the building

Learning Outcomes: At the end of this unit, students should be able to

- Write about the adoption of Economical Wall System. (L6)
- Write about Adoption of precast R.C. plank and join system for roof/floor in the building. (L6)

UNIT – IV (9 Hrs)

ALTERNATIVE BUILDING MATERIALS FOR LOW COST HOUSING AND INFRASTRUCTURE SERVICES IN RURAL HOUSES: Introduction - Substitute for scarce materials – Ferrocement - Gypsum boards - Timber substitutions - Industrial wastes - Agricultural wastes - Low cost Infrastructure services: Introduce - Present status - Technological options - Low cost sanitation - Domestic wall - Water supply, energy. Rural Housing**:** Introduction traditional practice of rural housing continuous - Mud Housing technology-Mud roofs - Characteristics of mud - Fire treatment for thatch roof - Soil stabilization - Rural Housing programs.

Learning Outcomes: At the end of this unit, students should be able to

- Determine about alternate building materials for low cost housing construction. (L3)
- Justify about low cost sanitation from traditional methods. (L6)

UNIT – V (9 Hrs)

HOUSING IN DISASTER PRONE AREAS: Introduction – Earthquake - Damages to houses -

Traditional prone areas - Type of Damages and Railways of non-engineered buildings - Repair and restore action of earthquake Damaged non-engineered buildings recommendations for future constructions. Requirements of structural safety of thin pre-cost roofing units against Earthquake forces -Status of R& D in earthquake strengthening measures - Floods, cyclone, future safety.

Learning Outcomes: At the end of this unit, students should be able to

- Explain about Type of Damages and Railways of non-engineered buildings. (L4)
- Express about Repair and restore action of earthquake Damaged structures and for future constructions. (L6)

TEXTBOOKS:

1. "Hand book of Low Cost Housing", A. K. Lal, New Age International publishers.
2. "Low Cost Housing", G.C. Mathur, IBH Publishers.
3. "Housing in India", Francis Cherunilam and Odeyar D Heggade, Himalaya Publishing House, Bombay, 1997.

REFERENCE BOOKS:

1. "Disaster Management", Rajib Shaw, Universities Press, India.
2. "Disaster Science and Management", Tushar Bhattacharya, TMH Publications.
3. "Building Materials For Low–Income Houses", International Council For Building Research Studies And Documentation.
4. "Modern Trends In Housing In Developing Countries", A.G. Madhava Rao, D.S. Rama Chandra Murthy & G. Annamalai.
5. "Properties of Concrete"', Neville A.M. Pitman Publishing Limited, London.
6. "Light Weight Concrete", Academic Kiado, Rudhai.G, Publishing home of Hungarian Academy of Sciences, 1963.

ONLINE LEARNING RESOURCES:

1. https://nptel.ac.in/courses/124107001
2. https://nptel.ac.in/courses/105103206
3. https://onlinecourses.nptel.ac.in/noc20_ar14/preview4

Course Code	ENERGY CONSERVATION AND MANAGEMENT		L	T	P	C
21A020507			**3**	**0**	**0**	**3**
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- Familiarize present energy scenario, and energy auditing methods.
- Explain components of electrical systems, lighting systems and improvements in performance. Demonstrate different thermal systems, efficiency analysis, and energy conservation methods.
- Train on energy conservation in major utilities.
- Instruct principles of energy management and energy pricing.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Explain Energy Utilization and Energy Auditing Methods. **(K3)**
CO2: Analyse Electrical Systems Performance of Electric Motors and Lighting Systems. **(K4)**
CO3: Examine Energy Conservation Methods in Thermal Systems. **(K3)**
CO4: Estimate Efficiency of Major Utilities Such as Fans, Pumps, Compressed Air Systems, Havoc and D.G. Sets. **(K2)**
CO5: Elaborate Principles of Energy Management, Programs, Energy Demand and Energy Pricing. **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction: Energy – Power – Past & Present Scenario of World; National Energy Consumption Data – Environmental Aspects Associated with Energy Utilization –Energy Auditing: Need, Types, Methodology And Barriers. Role of Energy Managers, Instruments for energy auditing.

Learning Outcomes: At the end of this unit, students should be able to

- Infer energy consumption patterns and environmental aspects of energy utilization. (L4)
- Outline energy auditing requirements, tools, and methods. (L3)
- Identify the function of energy manager. (L2)

UNIT – II (9 Hrs)

Electrical Systems: Components of EB Billing – HT And LT Supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors – Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of Lighting, Efficacy, LED Lighting And Scope Of Economy In Illumination.

Learning Outcomes: At the end of this unit, students should be able to

- Outline components of electricity billing, transmission, and distribution. (L3)
- Analyse performance characteristics of transformers, capacitors, and electric motors. (L4)
- Examine power factor improvements, and electric motor efficiency. (L3)
- Evaluate lighting systems. (L4)

UNIT – III (9 Hrs)

Thermal Systems: Stoichiometry, Boilers, Furnaces, and Thermic Fluid Heaters – Efficiency Computation and Encon Measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, and Insulators & Refractory's.

Learning Outcomes: At the end of this unit, students should be able to

- Determine efficiency of boilers, furnaces, and other thermal systems. (L3)
- Recommend energy conservation measures in thermal systems. (L2)
- Justify steam systems in energy conservation. (L3)

UNIT – IV (9 Hrs)

Energy Conservation in Major Utilities: Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. Sets.

Learning Outcomes: At the end of this unit, students should be able to

- Explain energy conservation measures in major utilities. (L3)
- Apply performance test criteria for fans, pumps, compressors, havoc systems. (L3)
- Assess energy conservation in cooling towers and D.G. sets. (L3)

UNIT – V (9 Hrs)

Energy Management: Principles of Energy Management, Energy demand estimation, Organizing and Managing Energy Management Programs, Energy pricing.

Learning Outcomes: At the end of this unit, students should be able to

- Describe principles of energy management. (L2)
- Assess energy demand and forecast, organize energy management programs. (L3)
- Design elements of energy pricing. (L5)

TEXTBOOKS:

1. "Energy Manager Training Manual", A Website Administered by Bureau of Energy Efficiency (BEE), A Statutory Body Under Ministry Of Power, Government of India, 2004, 4 Volumes Available at www.energymanagertraining.com

REFERENCE BOOKS:

1. "Industrial Energy Management and Utilisation", Witte. L.C., P.S. Schmidt, D.R. Brown, Hemisphere Publication, Washington, 1988.
2. "Design and Management for Energy Conservation", Callaghn, P.W., Pergamon Press, Oxford, 1981
3. "The Efficient Use of Energy", Dryden. I.G.C., Butter worths, London, 1982
4. "Energy Management", Murphy. W. R. and G. Mc Kay, Butter worths, London 1987

Course Code	BASICS OF POWER ELECTRONICS		L	T	P	C
21A020508			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- Understand the differences between signal level and power level devices.
- Analyze controlled rectifier circuits.
- Analyze the operation of DC-DC choppers.
- Analyze the operation of voltage source inverters

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand the operation, characteristics, and usage of power semiconductor devices. **(K2)**
CO2: Understand different types of Rectifier circuits with different operating conditions. **(K2)**
CO3: Understand DC-DC converters operation and analysis of their characteristics. **(K2)**
CO4: Understand the construction and operation of voltage source inverters. **(K2)**
CO5: Apply all the above concepts to solve various numerical problem solving. **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Power Switching Devices: Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET, IGBT and GTO.

Learning Outcomes: At the end of this unit, students should be able to

- Know the V-I characteristics of different semi-conductor devices. (L4)
- Importance of drive circuit for MOSFET, IGBT and GTO. (L3)

UNIT – II (9 Hrs)

Rectifiers: Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape, power factor and effect of source inductance.

Learning Outcomes: At the end of this unit, students should be able to

- Derivation of expressions of different configurations of rectifiers. (L3)

- Calculate the Average, R.M.S values of Voltages and Currents. (L4)

UNIT – III (8 Hrs)

DC-DC converters: Elementary chopper with an active switch and diode, concepts of duty ratio, control strategies and average output voltage: Power circuit, analysis and waveforms at steady state, duty ratio control and average output voltage of Buck, Boost and Buck- Boost Converters.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of duty cycle. (L2)
- Analysis of waveforms at steady state of power circuit. (L4)
- Derivation of average output voltage of DC-DC converter. (L3)

UNIT – IV (9 Hrs)

Inverter: Single phase Voltage Source inverters– operating principle - steady state analysis, Simple forced commutation circuits for bridge inverters –Voltage control techniques for inverters and Pulse width modulation techniques, single phase current source inverter with ideal switches, basic series inverter, single phase parallel inverter – basic principle operationally.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of pulse width modulation. (L2)
- Analysis of waveforms of single phase and three phase bridge inverters. (L4)

UNIT – V (10 Hrs)

AC voltage controllers & Cyclo converters: voltage controllers – Principle of phase control – Principle of integral cycle control - Single phase two SCRs in anti-parallel – With R and RL loads – modes of operation of TRIAC – TRIAC with R and RL loads– RMS load voltage, current and power actor-waveforms. Cyclo converters - Midpoint and Bridge connections - Single phase to single phase step-up and step-down Cyclo converters with Resistive load, Principle of operation, Waveforms, output voltage.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concept of the phase control and integral cycle control. (L2)
- Know the principal operation of voltage and frequency converter. (L4)
- Analysis waveforms of ac voltage converter and Cyclo converter. (L4)

TEXTBOOKS:

1. "Power Electronics: Circuits, Devices and Applications", M. H. Rashid, Prentice Hall of India, 2nd Edition, 1998
2. "Power Electronics", P. S. Bimbhra, Khanna Publishers, 4th Edition, 2010.
3. "Power Electronics", M. D. Singh & K. B. Khanchandani, Tata Mc Graw Hill Publishing Company, 1998.

REFERENCE BOOKS:

1. "Power Electronics", Ned Mohan, Wiley, 2011
2. "Fundamentals of Power Electronics", Robert W. Erickson and Dragan Maksimovic, Kluwer Academic Publishers, 2nd Edition, 2004
3. "Power Electronics", Vedam Subramanyam, New Age International (P) Limited, 1996.
4. "Power Electronics", V. R. Murthy, Oxford University Press, 1st Edition, 2005.
5. "Power Electronics", P. C. Sen, Tata Mc Graw-Hill Education, 1987
6. "Power Electronic Control of Alternating Current Motors", J. M. D. Murphy.

Course Code	BASICS OF AUTOMOTIVE ENGINEERING		L	T	P	C
21A030507			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To introduce various components of an automobile and engine sub systems.
- To impart knowledge on various safety systems of an automobile and emission norms.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Describe the various components of an automobile and Working of fuel supply system. **(K2)**
CO2: Know the working of various lubrication and cooling systems. **(K1)**
CO3: Familiarize with the various systems such as ignition system and transmission system. **(K2)**
CO4: Explain the suspension, braking systems of an automobile and their differences. **(K2)**
CO5: Know about the emissions from engine and safety norms for the operation of an automobile. **(K2)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction: classification of automobiles, Components of four wheeler automobile- chassis, body, power unit, power transmission- front wheel drive, rear wheel drive, four-wheel drive

Fuel supply systems: simple fuel supply system in petrol and diesel engines. Working of simple Carburetor, direct fuel injection system in diesel engine.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the parts of automobile engines. (L2)
- Understand the concept of fuel supply systems. (L2)

UNIT – II (7 Hrs)

Lubricating System: Functions & properties of lubricants, methods of lubrication splash, pressure, dry sump and wet sump lubrication.

Cooling System: Necessity, methods of cooling - air cooling & water cooling, components of water cooling, radiator, thermostat.

Learning Outcomes: At the end of this unit, students should be able to

- Analyze the function of Lubricating system. (L3)

UNIT – III (10 Hrs)

Ignition System: Functions, requirements, types of an ignition system, battery ignition system - components, Magneto ignition system, Electronic ignition system.

Transmission system: Types and functions of the clutches- single plate clutch, multi plate clutch, centrifugal and semi centrifugal clutch, Types of gear boxes- Sliding mesh, Constant mesh, Synchromesh, propeller shaft, universal joint and differential.

Learning Outcomes**:** At the end of this unit, students should be able to

- Understand the concept of Ignition system and its types. (L2)
- Understand the concept of Transmission system. (L2)

UNIT – IV (10 Hrs)

Suspension System: Objectives of suspension system, front suspension system rigid axle suspension system, independent suspension system, rear axle suspension, torsion bar, shock absorber.

Braking System: Mechanical brakes, hydraulic brakes-master cylinder, wheel cylinder, tandem master cylinder, brake fluid, air brakes and vacuum brakes.

Learning Outcomes**:** At the end of this unit, students should be able to

- Understand the working of suspension system and its types. (L2)
- Analyze the different types of braking systems. (L3)

UNIT – V (9 Hrs)

Emissions from Automobile: Emission norms - Bharat stage and Euro norms. Engine emissions - exhaust and non-exhaust.

Safety Systems: seat belt, air bags, bumper, antilock brake system (ABS), wind shield, suspension sensor, traction control, central locking, electric windows, speed control.

Learning Outcomes**:** At the end of this unit, students should be able to

- Understand emission concept in automobiles engines. (L2)
- Understand the concept of safety system. (L2)

TEXTBOOKS:

1. "Automobile Engineering Vol-1 & vol-2", Kirpal Singh, Standard Publishers Distributors, 11th Edition.
2. "Automotive Mechanics", William H Crouse & Donald LAnglin, Tata Mc Graw Hill Publications, 10th Edition.
3. "Automobile Engineering", Rajput, Laxmi Publications.

REFERENCE BOOKS:

1. "Automobile Engineering", R.B Gupta, Satya Prakashan Publications, 6th Edition.

2. "The Motor vehicle", Newton steeds & Garrett, Society of Automotive Engineers, 13th Edition.
3. "Automotive Engineering", G.B.S. Narang, Khanna Publishers, 5th Edition.
4. "Automotive Mechanics", Joseph Heitner, IPC Transport Press Ltd, 2nd Edition.
5. "The Automobile", Harbans Singh Reyat, S. Chand & company Pvt. Ltd., 6th Edition.

Course Code	BASICS OF TOTAL QUALITY MANAGEMENT		L	T	P	C
21A030508			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To understand the concept of quality, cost of quality, international quality standards.
- To learn the principles of Total quality management, techniques for problem solving.
- To learn about various tools of quality management used in various industrial applications.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand the concepts of Quality and Quality Control Techniques. **(K2)**
CO2: Understand TQM concepts and History and able to use quality tools for problem solving. **(K2)**
CO3: Use TQM techniques and to formulate quality circles to find solutions with team work. **(K2)**
CO4: Apply various TQM Methods to solve problems in industry. **(K3)**
CO5: Analyze various quality problems and contribute towards continuous improvement in the system. **(K4)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Inspection & Quality Control

Statistical Quality Control (SQC) – Techniques - variables and attributes Control charts : $\overline{X}$ - R Charts, P-Chart, C-Chart. Acceptance Sampling – Single and Double sampling Plan - OC Curves. BIS and ISO Standards – Importance.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various Control charts: $\overline{X}$ - R Charts, P-Chart, C-Chart, single and double sampling plans and BIS&ISO standards. (L1)

UNIT – II (8 Hrs)

TQM – concepts, History-Quality management philosophies-Juran, Deming, Crosby, Feigenbaum, Ishikawa– Stages of Evolution– continuous improvement – internal and external customers - TQM tools & techniques- 7 QC tools- 7 New QC tools.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various quality management philosophies, Evaluation of TQM, TQM tools and technologies. (L1)

<u>UNIT – III</u> (10 Hrs)

Problem solving process – corrective action – order of precedence – System failure analysis approach – flow chart – fault tree analysis – failure mode assessment and assignment matrix – organizing failure mode analysis – pedigree analysis, Quality circles – organization – team approach.

Learning Outcomes: At the end of this unit, students should be able to

- Analyse Problem solving process, system failure analysis, fault tree analysis, pedigree analysis and concept Quality circles. (L4)

<u>UNIT – IV</u> (10 Hrs)

Quality Function Development (QFD) – elements of QFD –benchmarking-Types- Advantages & limitations of benchmarking – Taguchi Analysis – loss function - Taguchi design of experiments. Poka-yoke, Kaizen, Deming cycle.

Learning Outcomes: At the end of this unit, students should be able to

- Know the procedure for quality function development, bench marking, taguchi analysis. (L1)

<u>UNIT – V</u> (8 Hrs)

Value improvement elements – value improvement assault – supplier teaming. Business process reengineering & elements of Supply chain management, Six sigma approach – application of six sigma approach to various industrial situations.

Learning Outcomes: At the end of this unit, students should be able to

- Know the value improvement, supplier teaming and the concept of business process re-engineering, supply chain management and six sigma. (L1)

<u>TEXTBOOKS:</u>

1. "Total Quality Management", D.R.Kiran, BS Publications, 2016
2. "Total Quality Management", Bester field, Pearson.

<u>REFERENCE BOOKS:</u>

1. "Quality management", Howard Giltow, TMH
2. "Quality management", Evans.
3. "Quality management", Bedi
4. "Total Quality Management", Joseph & Susan Berg

5. "Total Quality Management-Toward the Emerging Paradigm", Bounds, Yorks, Adams, Ranney, McGraHill, 1994

Course Code	CLOUD COMPUTING – AWS		L	T	P	C
21A050507			**3**	**0**	**0**	**3**
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- Define cloud services and models
- Demonstrate design the architecture for new cloud application.
- Explain how to re-architect the existing application for the cloud

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Apply the procedure for Cloud deployment. **(K3)**
CO2: Distinguish different cloud service models and deployment models. **(K3)**
CO3: Compare different cloud services. **(K4)**
CO4: Implementation of various services in cloud environment. **(K5)**
CO5: Design applications for an organization which use cloud environment. **(K5)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction to Cloud Computing: Introduction to Cloud Computing, Characteristics of Cloud Computing, Cloud Models, Cloud Services Examples, Cloud based services and Applications, Cloud Concepts and Technologies, Virtualization, Load Balancing, Scalability and Elasticity, Deployment, Replication, Monitoring, Software defined networking, Network function virtualization, Map Reduce, Identity and Access Management, Service Level Agreements, Billing.

Learning Outcomes: At the end of this unit, students should be able to

- Outline the Cloud characteristics and models. (L2)
- Classify different models, different technologies in cloud. (L2)

UNIT – II (9 Hrs)

Cloud Services and Platforms: Compute Services, Storage Services, Database Services, Application Services, Content Delivery Services, Analytics Services, Deployment and Management Services, Identity and Access Management Services, Open Source Private Cloud

Software, Apache Hadoop, Hadoop MapReduce Job Execution, Hadoop Schedulers, Hadoop Cluster Setup.

Learning Outcomes: At the end of this unit, students should be able to

- Summarize the Services and Platform of cloud. (L2)
- Demonstrate Hadoop Cluster Setup. (L2)

UNIT – III (9 Hrs)

Cloud Application Design: Design Considerations, Reference Architectures, Cloud Application Design Methodologies, Data Storage Approaches, Multimedia Cloud: Introduction, Case Study: Live Video Streaming App, Streaming Protocols, Case Study: Video Transcoding APP.

Learning Outcomes: At the end of this unit, students should be able to

- Design and build cloud applications. (L6)
- Describe the multimedia cloud. (L2)

UNIT – IV (10 Hrs)

Python for Amazon Web Services: Python for Amazon Web Services, Python Packages of Interest, Python Web Application Framework – Django, Designing a RESTful Web API.

Learning Outcomes: At the end of this unit, students should be able to

- Select different cloud services from different vendors. (L2)
- Utilize Python language to access cloud services. (L3)

UNIT – V (8 Hrs)

Case Study: Various Web Applications - Cloud Application Development in Python, Design Approaches, Image Processing APP, Document Storage App, Social Media Analytics App, Cloud Application Benchmarking and Tuning, Cloud Security, Cloud Computing for Education.

Learning Outcomes: At the end of this unit, students should be able to

- Investigate different Cloud applications. (L4)
- Design cloud applications using Python. (L6)

TEXTBOOKS:

1. “Cloud Computing: A Hands-on Approach”, Arshadeep Bhaga, Vijay Madisetti, Universities Press, 2018.

REFERENCE BOOKS:

1. “Azure in Action”, Chris Hay, Brian Prince, Manning Publications [ISBN: 9781935182481], 2010.
2. “Introducing Windows Azure” Henry Li, Apress, 1st Edition [ISBN: 978-14302-2469- 3], 2009.

Course Code	BASICS OF CRYPTOGRAPHY & NETWORK SECURITY		L	T	P	C
21A050508			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- Understand essential building blocks and basic concepts of cyber security
- Explore Web security and Network security
- Explain the measures for securing the networks and cloud
- Understand privacy principles and policies
- Describe the legal issues and ethics in computer security

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Illustrate the broad set of technical, social & political aspects of Cyber Security and security management methods to maintain security protection. **(K3)**

CO2: Assess the vulnerabilities and threats posed by criminals, terrorist and nation states to national infrastructure. **(K4)**

CO3: Identify the nature of secure software development and operating systems. **(K3)**

CO4: Demonstrate the role security management in cyber security defense. **(K2)**

CO5: Adapt the legal and social issues at play in developing solutions. **(K3)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Introduction: Introduction to Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control, and Cryptography, Authentication, Access Control, Cryptography Programs and Programming: Unintentional (Non-malicious) Programming Oversights, Malicious Code—Malware, Countermeasures.

Learning Outcomes: At the end of this unit, students should be able to

- Explain Vulnerabilities, threats and. Counter measures for computer security. (L2)
- Interpret the design of the malicious code. (L2)

UNIT – II (9 Hrs)

Web Security: User Side, Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks.

Operating Systems Security: Security in Operating Systems, Security in the Design of Operating Systems, Root kit.

Learning Outcomes: At the end of this unit, students should be able to

- Outline the attacks on browser, Web and email. (L2)
- Explain the security aspects of Operating Systems. (L3)

UNIT – III (9 Hrs)

Network Security: Network Concepts, Threats to Network Communications, Wireless Network Security, Denial of Service, Distributed Denial-of-Service Strategic Defenses: Security Countermeasures, Cryptography in Network Security, Firewalls, Intrusion Detection and Prevention Systems, Network Management.

Cloud Computing and Security: Cloud Computing Concepts, Moving to the Cloud, Cloud Security Tools and Techniques, Cloud Identity Management, Securing IaaS.

Learning Outcomes: At the end of this unit, students should be able to

- Identify the network security threats and attacks. (L3)
- Design the Counter measures to defend the network security attacks. (L4)
- Analyze the security tools and techniques for Cloud computing. (L4)

UNIT – IV (9 Hrs)

Privacy: Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, Data Mining, Privacy on the Web, Email Security, Privacy Impacts of Emerging Technologies, Where the Field Is Headed

Management and Incidents: Security Planning, Business Continuity Planning, Handling Incidents, Risk Analysis, Dealing with Disaster

Learning Outcomes: At the end of this unit, students should be able to

- Interpret the need for Privacy and its impacts of Emerging Technologies. (L2)
- Explain how to handle incidents and deal with Disaster. (L2)

UNIT – V (8 Hrs)

Legal Issues and Ethics: Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, Incident Analysis with Ethics, Emerging Topics: The Internet of Things, Economics, Computerized Elections, Cyber Warfare.

Learning Outcomes: At the end of this unit, students should be able to

- Adapt legal issues and ethics in computer security. (L4)
- Elaborate on the Emerging topics. (L4)

TEXTBOOKS:

1. "Security in Computing", Charles P. Fleeger, Prentice Hall, 5th Edition, 2010.
2. "Applied Cryptography", Bruce Schneier, John Wiley & Sons, 2nd Edition,1996

REFERENCE BOOKS:

1. "Information Security: The Complete Reference", Mark Rhodes-Ousley, 2nd Edition,
2. "Information Security Management: Concepts and Practice", McGraw-Hill, 2013.
3. "Roadmap to Information Security for IT and Infosec Managers", Michael E. Whitman and Herbert J. Mattord, Boston, MA: Course Technology, 2011

ONLINE LEARNING RESOURCES:

1. https://www.geeksforgeeks.org/cryptography-and-network-security-principles
2. https://onlinecourses.nptel.ac.in/noc22_cs90/preview

HONOURS

Course Code	ADVANCED MOSFET MODELING		L	T	P	C
21A04HN01			3	1	0	4
Pre-requisite	NIL	Semester	-			

COURSE OBJECTIVES:

- To Derive mathematical models for advanced MOS devices.
- To Provide solution to overcome short channel issues.
- To develop various compact models suitable for industry.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Develop knowledge on physics involved in modelling of semiconductor devices. **(K3)**
CO2: Develop knowledge on physics involved in MOSFET devices. **(K3)**
CO3: Analyze various MOSFETs to overcome short channel issues. **(K4)**
CO4: Model MOSFEET device for noise effects and process variations. **(K3)**
CO5: Develop various compact MOSFET models suitable for industry. **(K3)**

CO-PO MAPPING:

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

UNIT – I (12 Hrs)

BASIC DEVICE PHYSICS: Intrinsic and extrinsic semiconductors, direct and indirect semiconductors- Electrons and holes in silicon energy bands: electron and hole densities in equilibrium- Fermi Dirac statistics, carrier concentration, ionization of impurities. Carrier transport in silicon: drift current, diffusion current. pn junctions built in potential, electric field, current voltage characteristics.

Learning Outcomes: At the end of this unit, students should be able to

- Study the characteristics of different semiconductors. (L1)
- Understand the concepts of carrier concentration and transportation in Si. (L2)
- Understand the V-I characteristics of PN junction. (L2)

UNIT – II (12 Hrs)

MOSFET DEVICES: MOS capacitors surface potential- structure characteristics, electrostatic potential and charge distribution- threshold voltage- polysilicon work function- interface states and oxide traps. Long channel MOSFETs: threshold voltage, substrate bias and temperature dependence of threshold voltage, drain current model, subthreshold characteristics, channel mobility, capacitances.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the physics of MOSFETs. (L2)
- Derive the expression for threshold voltage of MOSFET. (L2)
- Explain the current model and subthreshold characteristics of MOSFETs. (L3)

UNIT – III (10 Hrs)

NANO SCALED MOSFETs: Scaling of MOSFETs: Short channel MOSFETs – short channel effects, velocity saturation, channel length modulation, DIBL, GIDL. Variability in MOSFETs. Reliability of MOSFETs high field effects, hot carrier degradation, negative bias temperature instability, MOSFET breakdown, high k dielectrics. Non classical MOSFETs: SOI MOSFETs Current voltage equations, fully depleted SOI MOSFETs, partially depleted SOI MOSFETs, Heterostructure MOSFETs, strained channel MOSFETs, Power MOSFETs, SiC MOSFETs-Silicon Nanowires-Carbon Nanotubes.

Learning Outcomes: At the end of this unit, students should be able to

- Explain various short channel effects of MOSFETs. (L3)
- Understand the effect of temperature and high electric fields on MOSFETs. (L2)
- Compare various non-classical MOSFETs. (L3)

UNIT – IV (8 Hrs)

NOISE MODELING AND PROCESS VARIATION: Noise sources in MOSFET: Flicker noise modeling, Thermal noise modeling- model for accurate distortion analysis- nonlinearities in CMOS devices and modeling- calculation of distortion in analog CMOS circuits. Influence of process variation- modeling of device mismatch for Analog/RF Applications- Benchmark circuits for quality assurance- Automation of the tests.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various noise sources in MOSFETs. (L2)
- Calculate distortion in analog CMOS circuits. (L3)
- Model the effects of process variations in different applications of MOSFETs. (L3)

UNIT – V (8 Hrs)

COMPACT MODELS FOR CIRCUIT SIMULATORS: Introduction to compact models, SPICE Level 1, 2 and 3 MOS models, BSIM model, EKV model, High frequency models-Parameter extraction of MOSFETs.

Learning Outcomes: At the end of this unit, students should be able to

- Explain various models of MOSFETs. (L3)
- Extract parameters of MOSFET device models. (L3)

TEXTBOOKS:

1. "Fundamentals of Modern VLSI Devices", Taur and T. H. Ning, Cambridge University Press, Cambridge, United Kingdom, 1998.
2. "Device Modeling for Analog and RF CMOS Circuit Design", Trond Ytterdal, Yuhua Cheng and Tor A. Fjeldly Wayne Wolf, John Wiley & Sons Ltd,2003.
3. "Solid State Electronic Devices", B. G. Streetman and S. Banarjee, 6th edition‖, Prentice Hall of India Pvt. Ltd, New Delhi, India, 2005.
4. "Semiconductor Devices – Modeling and Technology", N. Das Gupta and A. Das Gupta, Prentice Hall of India Pvt. Ltd, New Delhi, India, 2004.

REFERENCE BOOKS:

1. "Compact MOSFET Models for VLSI Design", A. B. Bhattacharyya, John Wiley & Sons Inc., 2009.
2. "Strained silicon hetero structures: materials and devices", C. K. Maiti, N. B. Chakrabarti, S. K. Ray, The Institution of Electrical Engineers, London, United Kingdom, 2001.
3. "BSIM 4 and MOSFET Modeling for IC simulation", Weidong Liuand Chemming Hu‖, World scientific and Publishing Co. Pvt. Ltd.2011

ONLINE LEARNING RESOURCES:

1. www.fairchildsemi.com/products/discretes/fets/
2. www.mosis.com/pages/Technical/Testdata/submicron-spice-parameters
3. en.wikipedia.org/wiki/Carbon_nanotube
4. www.nxp.com/wcm_documents/models/mos-models/model-9/aacd96_sel
5. web.cs.mun.ca/~paul/transistors/node3.html
6. www.elab.ntua.gr/bemos/index.html

Course Code	VLSI SIGNAL PROCESSING		L	T	P	C
21A04HN02			3	1	0	4
Pre-requisite	NIL	Semester	-			

COURSE OBJECTIVES:

- To acquire knowledge on signal processing system and various techniques of power reduction.
- To realize various adders and multipliers and optimize their operation by reducing the redundant operations
- To apply the concept of pipelined architecture for various combinational and sequential circuits.
- To design Low Power IIR filters

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Apply the signal processing techniques for power reduction. **(K3)**
CO2: Apply bit level arithmetic structures to design multipliers. **(K3)**
CO3: Realize various adders and optimize their operation by reducing the redundant operations. **(K3)**
CO4: Apply the concept of pipelined architecture for various combinational and sequential circuits. **(K3)**
CO5: Design low power IIR filters. **(K5)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Transformations for retiming. Folding and unfolding DSP programs.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various transformation techniques of DSP. (L2)
- Apply signal processing techniques for power reduction. (L3)

UNIT – II (11 Hrs)

Bit level arithmetic structures- parallel multipliers, interleaved floor plan and bit plan based digital filters. Bit serial multipliers. Bit serial filter design and implementation. Canonic signed digit arithmetic, Distributed arithmetic.

Learning Outcomes: At the end of this unit, students should be able to

- Understand bit level structures. (L2)
- Apply bit level structures to design multipliers. (L3)

- Design various digital filters. (L3)

UNIT – III (10 Hrs)

Redundant arithmetic, redundant number representations, carry free radix 2 addition and subtraction . Hybrid radix 4 addition. Radix 2 hybrid redundant multiplication architectures, data format conversion. Redundant to nonredundant converter. Numerical strength reduction.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various redundant and radix techniques. (L2)
- Apply redundant and radix techniques to realize various adders. (L3)

UNIT – IV (10 Hrs)

Synchronous pipelining and clocking styles, clock skew and clock distribution in bit level pipelined VLSI designs. Wave pipelining, constraint space diagram and degree of wave pipelining. Implementation of wave-pipelined systems. Asynchronous pipelining.

Learning Outcomes: At the end of this unit, students should be able to

- Understand pipelining structures. (L2)
- Apply different pipelining structures to implement digital systems. (L3)
- Implement synchronous and asynchronous pipelined architectures. (L3)

UNIT – V (10 Hrs)

Scaling versus power consumption. Power analysis, power reduction techniques, power estimation techniques. Low power IIR filter design. Low power CMOS lattice IIR filter.

Learning Outcomes: At the end of this unit, students should be able to

- Understand various power reduction techniques. (L2)
- Analyze and estimate the power consumption of digital circuits. (L4)
- Design low power IIR filters. (L5)

TEXTBOOKS:

1. "VLSI Digital Signal Processing systems", K.K. Parhi, John Wiley, 1999.
2. "VLSI and Modern Signal Processing", Kung S. Y, H. J. While House, T. Kailath, 1985, Prentice Hall.

REFERENCE BOOKS:

1. "Design of Analog – Digital VLSI Circuits for Telecommunications and Signal Processing", Jose E. France, Yannis Tsividis, 1994, Prentice Hall.
2. "VLSI Digital Signal Processing", Medisetti V. K, 1995, IEEE Press (NY), USA.

Course Code	CAD FOR VLSI		L	T	P	C
21A04HN03			3	1	0	4
Pre-requisite	NIL	Semester	-			

COURSE OBJECTIVES:

- To understand various phases of CAD for digital electronic systems, from digital logic simulation to physical design, including test and verification.
- To Optimize the implemented design for area, time and power by applying suitable constraints.
- To Gain knowledge on methodologies involved in design, verification and implementation of digital designs on reconfigurable hardware platform (FPGA)
- To Acquire knowledge on the methodologies involved in design, verification and implementation of digital designs on MCMs.
- To Develop various algorithms at various levels of physical design.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Establish comprehensive understanding of the various phases of CAD for digital electronic systems, from digital logic simulation to physical design, including test and verification. **(K3)**

CO2: Analyze physical design problems and employ appropriate automation algorithms for partitioning and floor planning. **(K4)**

CO3: Develop the algorithms of placement in physical design process. **(K3)**

CO4: Optimize the implemented design for area, timing and power by applying suitable constraints in routing. **(K4)**

CO5: Analyze the methodologies involved in design verification and implementation of digital designs on MCMs (Multi-Chip Modules). **(K4)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

VLSI Physical Design Automation VLSI Design Cycle, New Trends in VLSI Design Cycle, Physical Design Cycle, New Trends in Physical Design Cycle, Design Styles, System Packaging Styles.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the concepts of physical design and automation VLSI design cycle and its new trends. (L2)

- Establish comprehensive understanding of the various phases of CAD for digital electronic systems, from digital logic simulation to physical design, including test and verification. (L3)

UNIT – II (10 Hrs)

Partitioning, Floor Planning, Pin Assignment and Placement Partitioning – Problem formulation, Classification of Partitioning algorithms, Kernighan-Lin Algorithm, Simulated Annealing.
Floor Planning – Problem formulation, Classification of floor planning algorithms, constraint based floor planning, Rectangular Dualization, Pin Assignment – Problem formulation, Classification of pin assignment algorithms, General and channel Pin assignments.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the concepts of floor planning and various partitioning algorithms. (L3)
- Analyze physical design problems and employ appropriate automation algorithms for partitioning and floor planning (L4)

UNIT – III (10 Hrs)

Placement – Problem formulation, Classification of placement algorithms, Partitioning based placement algorithms.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the concepts of placement and partitioning based placement algorithms. (L3)

UNIT – IV (10 Hrs)

Global Routing and Detailed Routing Global Routing – Problem formulation, Classification of global routing algorithms, Maze routing algorithms, Detailed Routing – Problem formulation, Classification of routing algorithms, Single layer routing algorithms.

Learning Outcomes: At the end of this unit, students should be able to

- Explain the concepts of various routing algorithms. (L3)
- Optimize the implemented design for area, timing and power by applying suitable constraints. (L4)

UNIT – V (10 Hrs)

Physical Design Automation of FPGAs and MCMs FPGA Technologies, Physical Design cycle for FPGAs, Partitioning, Routing – Routing Algorithm for the Non-Segmented model, Routing Algorithms for the Segmented Model; Introduction to MCM Technologies, MCM Physical Design Cycle.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the fundamental concepts in CAD and to establish capability for CAD tool development and enhancement. (L2)
- Analyze the methodologies involved in design verification and implementation of digital designs on MCMs (Multi-Chip Modules). (L4)

TEXTBOOKS:

1. "Algorithms for VLSI Physical Design Automation", Naveed Shervani, 3rd Edition, 2005, Springer International Edition.
2. "CMOS Digital Integrated Circuits Analysis and Design", Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.

REFERENCE BOOKS:

1. "VLSI Physical Design Automation-Theory and Practice", Sadiq M Sait, Habib Youssef, World Scientific.
2. "Algorithms for VLSI Design Automation", S. H. Gerez, 1999, Wiley student Edition, John Wiley and Sons (Asia) Pvt. Ltd.
3. "VLSI Physical Design Automation", Sung Kyu Lim, Springer International Edition

Course Code	TEST AND TESTABILITY		L	T	P	C
21A04HN04			3	1	0	4
Pre-requisite	NIL	Semester	-			

COURSE OBJECTIVES:

- To understand various faults associated with logic circuits and types of testing by employing fault models to the logic circuits.
- To study different methods of simulation and algorithms associated with testing.
- To get in-depth knowledge in different methods of simulation and algorithms associated with testing.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Understand different types of faults associated with logic circuits and types of testing by employing fault models to the logic circuits. **(K2)**
CO2: Acquire verification knowledge and test evaluation. **(K5)**
CO3: Analyze the testability rules and techniques. **(K4)**
CO4: Acquire the knowledge of design of built-in-self test. **(K3)**
CO5: Utilize the scan architectures for different digital circuits. **(K3)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Introduction to Testing: Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, Fault Modeling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.

Learning Outcomes: At the end of this unit, students should be able to

- Understand different types of faults associated with logic circuits. (L2)
- Understand different types of testing by employing fault models to logic circuits. (L2)
- Study different types of defects and errors in the logic circuits. (L2)

UNIT – II (10 Hrs)

Logic and Fault Simulation: Simulation for Design Verification and Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation.

Learning Outcomes: At the end of this unit, students should be able to

- Acquire verification knowledge of various faults in the logic circuits. (L3)
- Analyze the faults using simulation tools. (L4)
- Apply the algorithms for true value and fault simulation. (L3)

UNIT – III (10 Hrs)

Testability Measures: SCOAP Controllability and Observability, High Level Testability Measures, Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan.

Learning Outcomes: At the end of this unit, students should be able to

- Define controllability and observability for a digital system. (L1)
- Identify schemes for introducing testability into digital circuits with improved fault coverage. (L3)
- Compare board level and chip level DFT approaches in testing. (L2)

UNIT – IV (10 Hrs)

Built-In Self-Test: The Economic Case for BIST, Random Logic BIST: Definitions, BIST Process, Pattern Generation, Response Compaction, Built-In Logic Block Observers, Test-Per-Clock, Test-Per-Scan BIST Systems, Circular Self Test Path System, Memory BIST, Delay Fault BIST.

Learning Outcomes: At the end of this unit, students should be able to

- Compare different BIST architectures. (L5)
- Perform memory test for the given memory block. (L3)
- Compare different approaches for introducing BIST into logic circuits, memories and embedded cores. (L5)

UNIT – V (10 Hrs)

Boundary Scan Standard: Motivation, System Configuration with Boundary Scan: TAP Controller and Port, Boundary Scan Test Instructions, Pin Constraints of the Standard, Boundary Scan Description Language: BDSL Description Components, Pin Descriptions.

Learning Outcomes: At the end of this unit, students should be able to

- Understand the Boundary Scan Standard. (L2)
- Analyze the TAP and controller and port. (L4)
- Apply the Boundary Scan test for different digital circuits. (L3)

TEXTBOOKS:

1. "Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits", M.L. Bushnell, V. D. Agrawal, Kluwer Academic Publishers.

2. "Digital Systems and Testable Design", M. Abramovici, M.A.Breuer and A.D Friedman, Jaico Publishing House.

REFERENCE BOOKS:

1. "Digital Circuits Testing and Testability", P.K. Lala, Academic Press.