ELECTRICAL AND ELECTRONICS ENGINEERING

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

Vision

- To be recognized for producing meritorious electrical engineers with research proficiency and social commitment

Mission

- To impart quality education with practice-based learning in producing electrical engineers with ethical values.
- To encourage the faculty and students to acquire mastery in cutting edge technologies.
- To implement research activities with social commitment.

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.

ELECTRICAL AND ELECTRONICS ENGINEERING

(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 Variable & Transforms	3	0	0	3	30	70	100
2	PC	21A020401	Electro Magnetic Fields	3	0	0	3	30	70	100
3	PC	21A020402	Electrical Circuit Analysis	3	0	0	3	30	70	100
4	PC	21A020403	Electrical Machines - I	3	0	0	3	30	70	100
5	ES	21A020307	Digital Electronic Circuits	3	0	0	3	30	70	100
6	PC	21A020404	Electrical Circuits & Simulation Lab	0	0	3	1.5	30	70	100
7	ES	21A020308	Digital Electronic Circuits Lab	0	0	3	1.5	30	70	100
8	PC	21A020405	Electrical Machines – I 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	21A030302	Engineering Mechanics	3	0	0	3	30	70	100
2	PC	21A020406	Analog Electronic Circuits	3	0	0	3	30	70	100
3	PC	21A020407	Electrical Machines – II	3	0	0	3	30	70	100
4	PC	21A020408	Control Systems Engineering	3	0	0	3	30	70	100
5	HSMC	21A110203	Managerial Economics & Financial Analysis	3	0	0	3	30	70	100
6	PC	21A020409	Electrical Machines – II Lab	0	0	3	1.5	30	70	100
7	PC	21A020410	Control Systems & Simulation Lab	0	0	3	1.5	30	70	100
8	PC	21A020411	Analog Electronics Circuits Lab	0	0	3	1.5	30	70	100
9	SC	21A020701	Electrical Engineering workshop - I	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	21A020412	Power System Architecture	3	0	0	3	30	70	100
2	PC	21A020413	Power Electronics	3	0	0	3	30	70	100
3	PC	21A020414	Electrical Measurements	3	0	0	3	30	70	100
4	OE-I		**Open Elective - I**	3	0	0	3	30	70	100
5	PE-I	21A020415 21A020416 21A020417	**Professional Elective - I** a) Design of Photovoltaic Systems b) Programmable Logic Controller and Applications a) Neural Networks & Fuzzy Logic	3	0	0	3	30	70	100
6	PC	21A020418	Power Electronics Lab	0	0	3	1.5	30	70	100
7	PC	21A020419	Electrical Measurement Lab	0	0	3	1.5	30	70	100
8	SC	21A050708	Web Designing	1	0	2	2	30	70	100
9	MC	21A000003	Universal Human Values	3	0	0	3	30	70	100
10	PROJ	21A020601	Internship – I Evaluation	0	0	0	1.5	0	0	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	21A020420	Power Semiconductor Drives	3	0	0	3	30	70	100
2	PC	21A020421	Power System Analysis	3	0	0	3	30	70	100
3	PC	21A020422	Digital Computing Platforms	3	0	0	3	30	70	100
4	PE-II	21A020423 21A020424 21A020425	**Professional Elective – II** a) Power system operation & Control b) Modern Control Theory c) Introduction to Hybrid and Electric Vehicles	3	0	0	3	30	70	100
5	OE-II		**Open Elective - II**	3	0	0	3	30	70	100
6	PC	21A020426	Power Systems Lab	0	0	3	1.5	30	70	100
7	PC	21A020427	Digital Computing Platforms Lab	0	0	3	1.5	30	70	100
8	PC	21A020428	Power converters using MATLAB/SIMULINK Lab	0	0	3	1.5	30	70	100
9	MC	21A000004	Research Methodology	2	0	0	0	30	---	---
10	SC	21A050704	Amazon Web Services	1	0	2	2	30	70	100
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	21A020429 21A020430 21A020431	**Professional Elective – III** a) Electrical Distribution Systems b) Power System Protection c) Switched Mode Power Converters	3	0	0	3	30	70	100
2	PE-IV	21A020432 21A020433 21A020434	**Professional Elective – IV** a) Electrical Machine Design b) Utilization of Electrical Energy c) Power Quality	3	0	0	3	30	70	100
3	PE-V	21A020435 21A020436 21A020437	**Professional Elective – V** a) Concepts of Digital Signal Processing b) Modern Power Electronics c) HVDC & FACTS	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	21A020702	IOT Applications In Electrical Engineering	1	0	2	2	100	0	100
8	PROJ	21A020602	Internship – II Evaluation	0	0	0	3	0	0	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	21A020603	Full Internship & Major Project	-	-	12	10	110	140	250
2	PROJ	21A020604	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	21A030501	Robotics
3	21A030502	Basics of Mechanical Engineering
4	21A040501	Integrated Circuits and Applications
5	21A040502	Introduction to Signal Processing
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	21A030503	Automation in Industries
3	21A030504	Rapid Prototyping
4	21A040503	Principles of Communication Systems
5	21A040504	Electronic Instrumentation
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	21A030505	Optimization Techniques
3	21A030506	Global Warming and Climate Changes
4	21A040505	Electronic Sensors
5	21A040506	Introduction to Image Processing
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	21A030507	Basics of Automotive Engineering
3	21A030508	Basics of Total Quality Management
4	21A040507	Principles of Cellular and Mobile Communications
5	21A040508	Embedded Systems
6	21A050507	Cloud Computing – AWS
7	21A050508	Basics of Cryptography & Network Security

COURSES OFFERED FOR HONOURS DEGREE IN EEE

S. No	Course Code	Course Title	Hours per week		Credits	CIE	SEE	Total
			L	T	C			
1	21A02HN01	Advanced Power Semiconductor Devices	3	1	4	30	70	100
2	21A02HN02	Applications of Power Electronics to Power Systems	3	1	4	30	70	100
3	21A02HN03	Reactive Power Compensation and Management	3	1	4	30	70	100
4	21A02HN04	Energy Efficient Electrical Systems	3	1	4	30	70	100
5	21A02HN05	MOOC – 1	-	-	2	-	-	-
6	21A02HN06	MOOC – 2	-	-	2	-	-	-

LIST OF MINORS OFFERED TO EEE

S. No	Course Code	Course Title	Department offering the course
1	21A040402	Pulse and Digital Circuits	ECE
2	21A040415	Data Communication and Networking	ECE
3	21A040433	Biomedical Signal Processing	ECE
4	21A040434	Radar Engineering	ECE
5	21A050415	Design and Analysis of Algorithms	CSE & ALLIED
6	21A050418	Mobile Computing	CSE & ALLIED
7	21A310402	Artificial Intelligence and Neural Networks	CSE & ALLIED
8	21A350401	Sensors and Internet of Things	CSE & ALLIED

Course Code	CALCULUS AND SPECIAL FUNCTIONS		L	T	P	C
21A110101	(Common to all branches)		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		L	T	P	C
21A020301	(Common to EEE & ECE)		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)
- To distinguish analogy between electric and magnetic circuits (L2)
- To understand analysis of series and parallel magnetic circuits (L2)

UNIT- II (12 Hours)

Network Topology: Definitions – Graph – Tree, Basic Cut-set and Basic Tie-set 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		L	T	P	C
21A050302	(Common to all branches)		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		L	T	P	C
21A030301	(Common to all branches)		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
"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, particularintegral, 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, the student will 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, the student will 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 withthe 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)

UNIT - II (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)

UNIT - III (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 solidby 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		L	T	P	C
21A040301	(Common to EEE & ECE)		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)

UNIT - II (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)

UNIT - III (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)

UNIT - IV (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 (Common to EEE, ECE, CSE, CSE-AI, AIML, CSE-IOT)		L	T	P	C
21A110108B			0	0	3	1.5
Pre-requisite	NIL	Semester	II			

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	ELECTRO MAGNETIC FIELDS		L	T	P	C
21A020401			3	0	0	3
Pre-requisite	Calculus and Special Functions	Semester	III			

COURSE OBJECTIVES:

- To understand the basic principles of electrostatics.
- To understand the basic principles of magneto statics for time invariant and time
- varying fields
- To understand the principles of dielectrics, conductors and magnetic potentials.

COURSE OUTCOMES:

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

CO1: Understand the concept of electrostatics
CO2: Understand the concepts of Conductors and Dielectrics
CO3: Understand the fundamental laws related to Magneto Statics
CO4: Understand the concepts of Magnetic Potential and Magnetic force
CO5: Understand the concepts of Time varying Fields

CO-PO MAPPING:

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

UNIT–I (10 Hrs)

Electrostatics: Electrostatics: Electrostatic Fields - Coulomb's Law - Electric Field Intensity (EFI) due to Line, Surface and Volume Charges-Electric Potential due to point charges, line charges and Volume Charges - Potential Gradient - Gauss's Law-Application of Gauss's Law-Maxwell's First Law- Numeric Problems. Laplace's Equation and Poisson's Equations - Solution of Laplace's Equation in one Variable. Electric Dipole - Dipole Moment - Potential and EFI due to Electric Dipole - Torque on an Electric Dipole in an Electric Field.

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

- Determine electric field and potentials using Coulomb's law & Gauss law. (L3)
- Analyze Potential differences for different configurations. (L4)
- Classify static electric magnetic fields in different engineering situations. (L2)
- Determine the Concepts of Electric dipole, Electrostatic Energy and Energy density. (L3)

UNIT–II (10 Hrs)

Conductors And Dielectrics: Behavior of Conductors in an Electric Field-Conductors and Insulators – Polarization – Dielectric Conductors and Dielectric Boundary Conditions. Capacitance-Capacitance of Parallel Plate, Spherical & Co-axial capacitors – Energy Stored and Energy Density in a Static Electric Field. Current Density – Conduction and Convection Current Densities – Ohm's Law in Point Form – Equation of Continuity – Numerical Problems.

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

- Analyze the Concepts of Conduction and Convection currents. (L4)
- Understand the concept of capacitance for parallel plates, spherical & co-axial capacitors. (L3)
- Calculate Energy stored and energy density in a static electric field. (L3)

UNIT–III (10 Hrs)

Magneto Statics: Static Magnetic Fields – Biot-Savart Law – Oersted's experiment – Magnetic Field Intensity (MFI) due to a Straight, Circular &Solenoid Current Carrying Wire – Maxwell's Second Equation. Ampere's Circuital Law and its Applications Viz., MFI Due to an Infinite Sheet of Current and a Long Current. Carrying Filament – Point Form of Ampere's Circuital Law – Maxwell's Third Equation – Numerical Problems.

Self and Mutual Inductances – Neumann's Formulae – Determination of Self Inductance of a Solenoid and Toroid and Mutual Inductance- Numerical Problems.

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

- Analyze the Concepts of Magnetic field intensity using Biot-Savart Law & Ampere Law. (L4)
- Understand Maxwell's equations. (L2)
- Develop MFI due to an infinite sheet of current and a long filament carrying conductor in Different loops. (L3)

UNIT–IV (10 Hrs)

Magnetic Potential & Magnetic Force: Scalar Magnetic Potential and Vector Magnetic Potential and its Properties - Vector Magnetic Potential due to Simple Configuration – Vector Poisson's Equations. Magnetic Force — Lorentz Force Equation – Force on Current Element in a Magnetic Field - Force on a Straight and Long Current Carrying Conductor in a Magnetic Field - Force Between two Straight and Parallel Current Carrying Conductors

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

- Understand scalar magnetic potential and vector magnetic potential and its applications. (L3)
- Calculate the magnetic forces and torque produced by currents in Magnetic Field. (L2)
- Calculate self and mutual Inductances. (L4)
- Analyze the Concepts of Magnetic boundary conditions & Energy stored in the Magnetic

field. (L4)

UNIT–V (10 Hrs)

Time Varying Fields: Faraday's Law of Electromagnetic Induction – It's Integral and Point Forms – Maxwell's Fourth Equation. Statically and Dynamically Induced E.M.F's – Simple Problems – Modified Maxwell's Equations for Time Varying Fields – Displacement Current. Wave Equations - Velocity, Wave Length, Intrinsic Impedance and Skin Depth – Poynting Theorem – Poynting Vector and its Significance.

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

- Acquire knowledge on time varying fields & Faraday's law for Electromagnetic induction (L3)
- Analyze the Concepts Maxwell's Equations in Different Forms. (L4)
- Understand the Concepts Calculation of Poynting vector & Theorem. (L3)
- Analyze the Concepts of Wave Theory (L4)

TEXTBOOKS:

1. "Engineering Electromagnetics", William. H. Hayt, McGraw Hill, 2010.
2. "Principles of Electromagnetics", Sadiku, Kulkarni, OXFORD University Press, 6th Edition, 2015.

REFERENCE BOOKS:

1. "Field Theory", K. A. Gangadhar, Khanna Publications, 2003.
2. "Electromagnetics", J. D. Kraus, McGraw – Hill Inc, 5th Edition, 1999.
3. "Electromagnetics", Joseph Edminister, Tata Mc Graw Hill, 2006.

Course Code	ELECTRICAL CIRCUIT ANALYSIS		L	T	P	C
21A020402			3	0	0	3
Pre-requisite	Fundamentals of Electrical Circuits	Semester	III			

COURSE OBJECTIVES:

- To know the analysis of the series and parallel resonance circuits.
- Knowing how to determine the transient response of R-L, R-C, R-L-C series circuits for D.C.
- To study the network parameters for given two port networks
- To know the applications of Fourier transforms to electrical circuits excited by non-sinusoidal sources.
- Design symmetrical and unsymmetrical passive the filters.

COURSE OUTCOMES:

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

CO1: Analyze the various locus diagrams and Resonance circuits

CO2: Calculate the various two-port network parameters

CO3: Calculate the transient response of R-L, R-C, R-L-C series circuits for D.C and A.C excitations.

CO4: Applications of Fourier transforms to electrical circuits excited by non-sinusoidal sources are known.

CO5: Design the filters, equalizers and PSPICE programs for Circuit Analysis.

CO-PO MAPPING:

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

UNIT – I (12 Hrs)

Locus Diagrams & Resonance: Series R-L, R-C, R-L-C and Parallel Combination with Variation of Various Parameters - Resonance-Series, Parallel Circuits, Frequency Response, Concept of Bandwidth and Q Factor.

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

- Learn about basic concepts of Locus diagrams with different parameter variations of Electrical circuit elements (L2)
- Learn about occurrence of resonance with the presence of electrical circuit elements under certain operating conditions(L2)

UNIT – II (12 Hrs)

Two Port Networks: Two Port Network Parameters – Impedance – Admittance - Transmission and Hybrid Parameters and inverse hybrid parameters, relationship between parameters, interconnection of two port networks. Series and Parallel connection of two port networks.

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

- Understand and estimate the network parameters of T & π configurations of DC circuits or resistive elements(L2)
- Understand how Laplace transforms studied in mathematics courses, can be applied to identify energy storage elements in electrical circuits(L3)

UNIT – III (12 Hrs)

Transient Analysis: D.C Transient Analysis: Transient Response of R-L, R-C, R-L-C Series Circuits for D.C Excitation - Initial Conditions in network - Initial Conditions in elements - Solution Method Using Differential Equation and Laplace Transforms - Response of R-L & R-C Networks to Pulse Excitation.

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

- Distinguish between classical method and Laplace transform approach in analysing transient phenomenon in DC excitations (L3)
- Distinguish between classical method and Laplace transform approach in analysing transient phenomenon in sinusoidal excitations (L4)

UNIT – IV (12 Hrs)

Fourier Series & Fourier Transforms: Fourier Theorem - Trigonometric Form and Exponential Form of Fourier series – Conditions of Symmetry - Line Spectra and Phase Angle Spectra - Analysis of Electrical Circuits to Non-Sinusoidal Periodic Waveforms. Fourier Integrals and Fourier Transforms – Properties of Fourier Transforms and Application to Electrical Circuits.

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

- Apply Fourier transforms studied in Mathematics to Electrical circuits for non-sinusoidal periodic and non-periodic input waves (L4)
- Understand properties of Fourier series and Transforms (L2)

UNIT – V (12 Hrs)

Filter Design: Introduction, the Neper & decibel, Characteristic Impedance of symmetrical networks, the propagation constant, Properties of symmetrical networks, Filter fundamentals; pass and stop bands, Behavior of characteristic impedance, The constant – k low pass filter, the constant – k high pass filter.

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

- Understand about what is a Filter, Classification, where they can be used, etc. (L2)
- Understand about attenuators and equalizers used in electronic high frequency circuit(L2)

TEXTBOOKS:

1. "Engineering Circuit Analysis", William Hayt, Jack E. Kemmerly and Jamie Phillips, McGraw Hill, 9th Edition, 2019.
2. "Fundamentals of Electric Circuits", Charles K. Alexander and Matthew. N. O. Sadiku, Mc Graw Hill, 5th Edition, 2013.

REFERENCE BOOKS:

1. "Circuit Theory: Analysis & Synthesis", A. Chakrabarti, Dhanpat Rai & Sons, 2008
2. "Electrical Engineering Fundamentals", V. Del Toro, Prentice Hall International, 2009.
3. "Circuits and Networks: Analysis and Synthesis", A Sudhakar and Shyam Mohan SP, TMH, 5th Edition, 2015
4. "Electric Circuits" Mahamood Nahvi and Joseph Edminister, Schaum's Series, 6th Edition, 2013.
5. "Network Analysis", M.E. Van Valkenberg, Prentice Hall (India), 3rd Edition, 1980

Course Code	ELECTRICAL MACHINES - I		L	T	P	C
21A020403			3	0	0	3
Pre-requisite	Fundamentals of Electrical Circuits	Semester	III			

COURSE OBJECTIVES:

- Study magnetic materials, electromechanical energy conversions, principle and operation of DC machines and transformers and starters.
- understand the constructional details of DC machines and Transformers
- Analyze the performance characteristics of DC machines and transformer
- Evaluate efficiency, regulation and load sharing of DC machines and transformers
- Design Equivalent circuit of transformer

COURSE OUTCOMES:

After completion of the course the student will be able to

CO1: Able Understand the concepts of magnetic circuits, principle and operations of DC machines, starters and single and three phase transformers.

CO2: Able to understand the construction, operation and armature windings of a DC generator and also able to analyze the characteristics of DC generators

CO3: Evaluate generated emf, back emf, speed, efficiency and regulations of DC machines

CO4: Analyze single phase transformer operation and characteristics.

CO5: Analyze three phase transformer operation and characteristics.

CO-PO MAPPING:

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

UNIT–I (12 Hrs)

Magnetic Material Properties and Applications:

Introduction, Magnetic materials and their properties, magnetically induced emf and force, AC operation of magnetic circuits, hysteresis and eddy current losses, permanent magnets, and applications of permanent magnet materials.

Principles of electromechanical energy conversion:

Energy in magnetic system, field energy and mechanical force, multiply-excited magnetic field systems, forces/torques in systems with permanent magnets, energy conversion via electric field, dynamical equations of electro mechanical systems

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

- Understand the electromechanical energy conversion system (L2)
- Understand various magnetic materials, properties and Applications (L2)

UNIT–II (12 Hrs)

DC Generators: Constructional details of DC machine, principle of operation of DC generator, armature windings and its types, emf equation, armature reaction, effect of brush lead, demagnetizing and cross magnetizing ampere turns, compensating windings, commutation, emf induced in a coil undergoing commutation, methods of improving commutation, OCC and load characteristics of different types of generators.

Parallel operation of DC Generators: DC shunt and series generators in parallel, equalizing connections

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

- Understand the construction, operation and armature windings of a DC generator(L2)
- Analyze the characteristics of DC generators (L4)

UNIT–III (12 Hrs)

DC Motors: Force on conductor carrying current, back emf, Torque and power developed by armature, speed control of DC motors (Armature control and Flux control methods), Necessity of starters, constructional details of 3-point and 4-point starters, characteristics of DC motors, Losses in DC machines, condition for maximum efficiency

Testing of DC machines: Brake test, Swinburne's test, Hopkinson's test, Fields test, Retardation test.

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

- Analyze speed control of DC motors, testing methods and parallel operation of DC machines (L4)
- Analyze the characteristics of DC motors (L4)

UNIT–IV (12 Hrs)

Single Phase Transformers: Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagrams (no load and on load), Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, losses and efficiency Testing - open circuit and short circuit tests, voltage regulation, Sumpner's test, separation of hysteresis and eddy current losses. Parallel operation of single-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer.

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

- Understand the construction, operation and parallel operation of transformer (L2)
- Predetermine the efficiency and regulation of a transformer (L4)

UNIT–V (12 Hrs)

Three Phase Transformers: Three-phase transformer – construction, types of connection and their comparative features, Phase conversion - Scott connection, Tap-changing transformers - No-load and on-load tap- changing of transformers, Three-winding transformers- Cooling of transformers

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

- Understand and analyze the phase conversions (L3)
- Analyze the tap changing of transformers (L4)

TEXTBOOKS:

1. "Electric Machines", I. J. Nagrath & D. P. Kothari, Tata Mc Graw – Hill Publishers, 3rd Edition, 2004.
2. "Electrical Machines" – P.S. Bimbhra, Khanna Publishers, 2011.

REFERENCE BOOKS:

1. "Performance and Design of D.C Machines", Clayton & Hancock, BPB Publishers, 2004.
2. "Electrical Machines", S.K. Battacharya, TMH Edn Pvt. Ltd., 3rd Edition, 2009.
3. "Electric Machinary", A. E. Fitzgerald, C. Kingsley and S. Umans, McGraw-Hill Companies, 5th Edition, 2003.
4. "Electrical Machines", M.V Deshpande, Wheeler Publishing, 2004.
5. "Electromechanics – I", Kamakshaiah S., Overseas Publishers Pvt. Ltd, 3rd Edition, 2004.

Course Code	DIGITAL ELECTRONIC CIRCUITS		L	T	P	C
21A020307			3	0	0	3
Pre-requisite	Electronic Devices & Circuits	Semester	III			

COURSE OBJECTIVES:

- To teach significance of number systems, conversions, binary codes and functionality of logic gates.
- To discuss different simplification methods for minimizing Boolean functions.
- To impart knowledge on operation, characteristics and various configurations of TTL and CMOS logic families.
- To outline procedures for the analysis and design of combinational and sequential logic circuits.
- To introduce programmable logic devices.

COURSE OUTCOMES:

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

CO1: Understand various number systems, error detecting, correcting binary codes, logic families, combinational and sequential circuits.

CO2: Apply Boolean laws, k-map and Q-M methods to minimize switching functions. Also describe the various performance metrics for logic families.

CO3: Design combinational and sequential logic circuits.

CO4: Compare different types of Programmable logic devices and logic families.

CO5: Analyze the various Logic families

CO-PO MAPPING:

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

UNIT - I (12 Hrs)

Number Systems and Codes: Decimal, Binary, Octal, and Hexa-decimal number systems and their conversions, ASCII code, Excess -3 codes, Gray code. Binary codes Classification, Error detection and correction – Parity generators and checkers –Fixed point and floating-point Arithmetic.

Boolean Algebra& Logic Gates: Boolean operations, Boolean functions, Algebraic manipulations, Min-terms and Maxterms, Sum-of-products and Product-of-sum representations, Two-input logic gates, NAND /NOR implementations.

Minimization of Boolean Functions: Karnaugh map, Don't-care conditions, Prime implicants, Minimization of functions using Quine-McClusky method.

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 and functionality of logic gates. (L2)
- 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)

UNIT - II (12 Hrs)

Combinational Circuits: Introduction, Analysis of combinational circuits, Design Procedure– Binary Adder-Subtractor, Decimal Adder, Multiplier, Comparator, Code Converters, Encoders, Decoders, Multiplexers, Demultiplexers, Illustrative examples

Sequential Circuits-1: Introduction, Latches –RS latch and JK latch, Flip-flops-RS, JK, T and D flip flops, Master-slave flip flops, Edge-triggered flip-flops, Flip-flop conversions.

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

- Apply Boolean algebra for describing combinational digital circuits. (L2)
- Analyze standard combinational circuits such as adders, subtractors, multipliers, etc. (L4)
- Design various Combinational logic circuits. (L4)
- Implement logic functions with decoders and multiplexers. (L5)

UNIT - III (12 Hrs)

Sequential Circuits-2: Analysis and Design of Synchronous Sequential Circuits: Moore and Mealy machine models, State Equations, State Table, State diagram, State reduction & assignment, Synthesis using flip flops, Elements of Design style, Top–down design, Algorithmic state Machines (ASM), ASM chart notations.

Registers and Counters: Registers, shift registers, Ripple counters, Synchronous counters, Modulus-n Counter, Ring counter, Johnson counter, Up-Down counter.

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. (L5)
- Design synchronous sequential circuits using flip flops and construct digital systems
- Use components such as registers and counters (L4)
- Utilize concepts of state and state transition for analysis and design of sequential circuits (L3)

UNIT - IV (12 Hrs)

Memory and Programmable Logic: RAM, Types of Memories, Memory decoding, ROM, Types of ROM, Programmable Logic Devices (PLDs): Basic concepts, PROM as PLD, Programmable Array Logic (PAL) and Programmable Logic Array (PLA), Design of combinational and sequential circuits using PLDs.

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

- Define RAM, ROM, PROM, EPROM and PLDs. (L1)
- Describe functional differences between different types of RAM & ROM. (L2)
- Compare different types of Programmable Logic Devices. (L5)
- Design simple digital systems using PLDs. (L4)

UNIT-V (12 Hrs)

Digital Logic Families: Unipolar and Bipolar Logic Families, Transistor-Transistor Logic (TTL): Operation of TTL, Current sink logic, TTL with active pull up, TTL with open collector output, Shockley TTL, TTL characteristics, I2L, ECL logic Families.

CMOS: CMOS Inverter, CMOS characteristics, CMOS configurations - Wired Logic, Open drain outputs, Interfacing: TTL to CMOS and CMOS to TTL, Tristate Logic, Characteristics of Digital ICs: Speed, power dissipation, figure of merit, fan-out, Current and voltage parameters, Noise immunity, operating temperature range, power supply requirements.

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

- Summarize significance of various TTL, I2L, ECL and CMOS subfamilies. (L2)
- Examine Interface aspects of TTL & CMOS logic families. (L5)
- Explain characteristics of digital ICs such as speed, power dissipation, figure of merit, fan-out, noise immunity etc. (L2)
- Compare bipolar and MOS logic families. (L5)

TEXTBOOKS:

1. "Digital Design", M. Morris Mano and Michael D. Ciletti, Pearson Education, 4th Edition, 2013.
2. "Switching and Finite Automata Theory", Z. Kohavi and N. K. Jha, Tata McGraw Hill, Third Edition, 2010.
3. "Modern Digital Electronics", R. P. Jain, McGraw Hill Education, India Private Limited, 4th Edition, 2012.

REFERENCE BOOKS:

1. "Digital Design: Principles and Practices", J.F Wakerly, Pearson India, 4th Edition, 2008.
2. "Fundamentals of Logic Design", Charles H Roth (Jr) and Larry L. Kinney, Cengage Learning India Edition, 5th Edition, 2010.
3. "Digital Logic Applications and Design", John. M Yarbrough, Thomson Learning, 2006

Course Code	ELECTRICAL CIRCUITS & SIMULATION LABORATORY		L	T	P	C
21A020404			0	0	3	1.5
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- Understand and experimentally verify various resonance phenomenon
- Understand and analyze various current locus diagrams.
- Apply and experimentally analyze the basic two port network parameters
- To understand the fundamentals of electrical circuits by using PSPICE software.

COURSE OUTCOMES:

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

CO1: Understand and compare basic electric circuit theorems with actual working circuits.

CO2: Students can Design and understand RLC series and parallel circuits and its resonance condition.

CO3: They can able to measure power in three phase circuits in day to day life.

CO4: They can also be able to understand simulation programs for DC circuit analysis using PSPICE.

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. Locus Diagram of RL Series Circuits:
   a) Variable ‘R’ and Fixed ‘L’ b) Variable ‘L’ and Fixed ‘R’
2. Locus Diagram of RC Series Circuits:
   a) Variable ‘R’ and Fixed ‘C’ b) Variable ‘C’ and Fixed ‘R’
3. Series Resonance
4. Parallel Resonance
5. Transient response of RL and RC circuits for DC circuits
6. Determination of Z Parameters
7. Determination of Y Parameters
8. Transmission Parameters
9. Hybrid Parameters
10. Design of low pass and high pass filters

PSPICE SIMULATION EXPERIMENTS:

1. Simulation of DC Circuits
2. Simulation of AC Circuits
3. Simulation of low pass and high pass filters
4. DC Transient Response
5. Mesh Analysis
6. Nodal Analysis

REFERENCE BOOKS:

1. "Fundamentals of Electric Circuits: Lab Manual", David A. Bell, OUP Canada, 7th Edition, 2009.
2. "Introduction to PSPICE using OrCAD for Circuits and Electronics", Muhammad H. Rashid, Pearson Education, 3rd Edition, 2003.

Course Code	DIGITAL ELECTRONIC CIRCUITS LAB		L	T	P	C
21A020308			0	0	3	1.5
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
- To understand common forms of number representation in digital electronic circuits and to be able to convert between different representations.
- To implement simple logical operations using combinational logic circuits
- To design combinational logic circuits, sequential logic circuits.
- To impart to student the concepts of sequential circuits, enabling them to analyze sequential systems in terms of state machines.
- To implement synchronous state machines using flip-flops.

COURSE OUTCOMES:

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

CO1: Understand working of logic families and logic gates.
CO2: Design and implement Combinational and Sequential logic circuits.
CO3: Understand the process of Analog to Digital conversion and Digital to Analog conversion.
CO4: Use PLDs to implement the given logical problem.

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

LIST OF EXPERIMENTS:

1. To study basic gates (AND, OR, NOT) and verify their truth tables.
2. Design and realization of logic gates using universal gates
3. Realization of Boolean Expressions using Gates
4. Design a 3 – bit Adder / Subtractor
5. Design and realization a 4 – bit gray to Binary and Binary to Gray Converter
6. Design and construct basic flip-flops R-S, J-K, J-K Master slave flip-flops using gates and verify their truth tables
7. Design and realization a Synchronous counters using flip-flops
8. Design and realization of Asynchronous counters using flip-flops
9. Design and realization of 8x1 MUX using 2x1 MUX
10. Realization of logic gates using DTL, TTL, ECL, etc
11. Design and realization 2-bit comparator

12. Design and realization of 8-bit parallel load and serial out shift register using flip-flops
13. Design and realization of 4-bit pseudo random sequence generator using logic gates.
14. State machines

Note: Any 10 experiments should be performed

TEXTBOOKS:

1. "Digital Design", M. Morris Mano and Michael D. Ciletti, Pearson Education, 4th Edition, 2013.
2. "Switching and Finite Automata Theory", Z. Kohavi and N. K. Jha, Tata McGraw Hill, Third Edition, 2010.
3. "Modern Digital Electronics", R. P. Jain, McGraw Hill Education, India Private Limited, 4th Edition, 2012.

REFERENCE BOOKS:

1. "Digital Design: Principles and Practices", J.F Wakerly, Pearson India, 4th Edition, 2008.
2. "Fundamentals of Logic Design", Charles H Roth (Jr) and Larry L. Kinney, Cengage Learning India Edition, 5th Edition, 2010.
3. "Digital Logic Applications and Design", John. M Yarbrough, Thomson Learning, 2006

Course Code	ELECTRICAL MACHINES – I LAB		L	T	P	C
21A020405			0	0	3	1.5
Pre-requisite	NIL	Semester	III			

COURSE OBJECTIVES:

- DC motors and DC Generators
- The speed control techniques of DC motors.
- To conduct various experiments for testing on 1-phase transformers

COURSE OUTCOMES:

After completion of the course the student will be able to

CO1: Conduct and analyze load test on DC shunt generator
CO2: Understand and analyze magnetization characteristics of DC shunt generator
CO3: Understand and analyze speed control techniques and efficiency of DC machines
CO4: Understand to predetermine efficiency and regulation of single-phase Transformers.

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. Magnetization characteristics of DC shunt generator. Determination of critical field resistance and critical speed.
2. Load test on DC shunt generator. Determination of characteristics.
3. Brake test on DC shunt motor. Determination of performance curves.
4. Swinburne's test on DC shunt motor, Predetermination of efficiency.
5. Speed control of DC shunt motor (Armature control and Field control method).
6. Hopkinson's tests on DC shunt machines. Predetermination of efficiency.
7. OC and SC test on single phase transformer
8. Parallel operation of single-phase transformers.
9. Sumpner's test on single phase transformers.
10. Load test on DC long shunt compound generator. Determination of characteristics.
11. Load test on DC short shunt compound generator. Determination of characteristics.
12. Separation of losses in DC shunt motor.

13. Separation of losses of single-phase transformer.

Note: Minimum ten experiments are required to be performed from the above list

REFERENCE BOOKS:

1. "Laboratory Manual for Electrical Machines", D. P. Kothari and B. S. Umre**,** I.K International Publishing House Pvt. Ltd., 2017.

ONLINE LEARNING RESOURCES:

1. http://em-coep.vlabs.ac.in/List%20of%20experiments.html?domain=ElectricalEngineering
2. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/experimentlist.html

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
17. Time in "the epoch", which is an arbitrary time used as a reference point

    a. >>> import time

b. >>>time.time () 14377460

a. 94.5735958

18. 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.
19. Given a text of characters, write a program which counts number of vowels, consonants and special characters.
20. 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
21. 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.
22. 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:

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

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

CO2: Understand the functioning of three wings of the government ie., executive, legislative and judiciary.

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

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

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

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 (10 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 (10 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 (10 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 (10 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 (10 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	ENGINEERING MECHANICS		L	T	P	C
21A030302	(Common to ME & EEE)		3	0	0	3
Pre-requisite	NIL	Semester	IV			

COURSE OBJECTIVES:

- Develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering.
- To learn the effect of friction on equilibrium.
- To learn kinematics, kinetics of particle and rigid body, related principles.
- Understand Moment of force, Varignon's theorem with applications, couple.

COURSE OUTCOMES:

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

CO1: Ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
CO2: Analyze the forces in the members of the frames/truss.
CO3: Understand the concept of friction and its applications.
CO4: Understand the concept of centroid and location of centroid of plane figures and material bodies.
CO5: Understand moment of inertia, determining moment of inertia of plane figures and material bodies.

CO-PO MAPPING:

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

UNIT - I (12 Hrs)

Introduction to Engineering Mechanics: Basic concepts - System of forces–Resultant of a force system, Moment of forces and its Application & Couples, Spatial Forces-Components in space, Resultant Equilibrium of system forces, free body diagrams.

Types of Supports: Support reactions for beams with different types of loading – concentrated, uniformly distributed load, uniformly varying loading and couple.

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

- Use scalar and vector analytical techniques for analyzing forces (L4)
- Calculate resultant and apply conditions of equilibrium. (L3)

- Demonstrate knowledge of mathematics and mechanics with logics in resolution and composition of force systems. (L3)

UNIT - II (14 Hrs)

Analysis of Perfect Frames: Types of frames – cantilever frames and simply supported frames – Analysis of frames using method of joints, Tension Coefficient method and methods of sections for vertical loads, horizontal loads and inclined loads.

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

- Understand types of frames and analyze for the forces in the members of the truss by method of joints and method of sections. (L4)
- Analysis of truss, cable, frame and friction. (L4)
- Identify the type of frame and analyze for the forces in the members of the truss (frame) by method of joints and method of sections. (L4)

UNIT - III (12 Hrs)

Friction: Types of friction– Static and Dynamic Frictions, laws of Friction–Limiting friction and impending motions–Cone of limiting friction– Motion of bodies – Wedge friction – Screw jack.

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

- Understand the basic concepts of friction(L2)
- Understand various types of friction. (L2)
- Apply type motions and also understand applications of friction. (L3)

UNIT - IV (16Hrs)

Centroid and Centre of Gravity: Centroids of simple figures – Centroids of Composite figures – Centre of Gravity of bodies -Centre of Gravity of Composite figures. (Simple problems only)

Moment of Inertia: Area moment of Inertia - Parallel axis and perpendicular axis theorems - Moments of Inertia of Composite Figures.

Moment of Inertia: Moment of Inertia of Simple solids, Moment of Inertia of composite masses. (Simple problems only)

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

- Understand distributed force systems, Centroid centre of gravity and method of finding Centroids of composite figures and bodies. (L2).
- Understand the moment of inertia and method of finding moment of inertia of areas and bodies. (L2)
- Understand the mass moment of inertia of different solid materials. (L2)

UNIT-V (14 Hrs)

Kinematics: Rectilinear and Curvilinear motion – Velocity and Acceleration – Motion of A Rigid Body – Types and their Analysis in Planar Motion.

Kinetics: Analysis as a particle and Analysis as a Rigid Body in Translation – Central Forces of motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies

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

- Understand practical examples related to curvilinear motion. (L2)
- Relate kinematics with kinetic equations on linear displacement, velocity and acceleration. (L4)
- Understand the work energy, energy, power, potential energy (L2)
- Understand Kinetics of rigid body rotation. (L2)

TEXTBOOKS:

1. "Engineering Mechanics-Statics and Dynamics", A. Nelson, Tata McGraw Hill Company.
2. "Engineering Mechanics", R.K Bansal, Laxmi Publications
3. "Engineering Mechanics", Bhavikatti and Rajasekharappa

REFERENCE BOOKS:

1. "Engineering Mechanics", S. Timoshenko, D. H. Young and J. V. Rao, Tata McGraw Hill Company
2. "Engineering Mechanics", Ferdinand L. Singer – Harper Collings Publishers

Course Code	ANALOG ELECTRONIC CIRCUITS		L	T	P	C
21A020406			3	0	0	3
Pre-requisite	NIL	Semester	IV			

COURSE OBJECTIVES:

- List various types of feedback amplifiers, oscillators and large signal Amplifiers.
- Explain the operation of various electronic circuits and linear ICs.
- Apply various types of electronic circuits and regulated power supplies for proper understanding
- Justify choice of transistor configuration in a cascade amplifier.
- Design electronic circuits for a given specification.

COURSE OUTCOMES:

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

CO1: Discuss various types of feedback amplifiers, oscillators and large signal amplifiers
CO2: Explain the operation of various electronic circuits and linear ICs
CO3: Apply various types of electronic circuits to solve engineering problems
CO4: Justify choice of transistor configuration in a cascade amplifier
CO6: Design electronic circuits for a given specification

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)

Multistage Amplifiers: Classification of amplifiers, different coupling schemes used in amplifiers, general analysis of cascade amplifiers, Choice of transistor configuration in a cascade amplifier, frequency response and analysis of two stage RC coupled and direct coupled amplifiers, principles of Darlington amplifier, Cascade amplifier.

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

- Name different coupling schemes in amplifiers (L1)
- Explain the principles of Darlington amplifier (L2)
- Apply multistage amplifiers to solve engineering problems (L3)
- Analyse multistage amplifiers (L4)
- Justify choice of transistor configuration in a cascade amplifier (L5)

UNIT - II (12 Hrs)

Feedback Amplifiers: Concepts of Feedback, Classification of Feedback Amplifiers, Transfer Gain with Feedback, General Characteristics of Negative-Feedback Amplifiers, Effect of Feedback on Amplifier characteristics, Analysis of a feedback Amplifiers – Voltage – Series, Current-Series, Current-shunt and Voltage – shunt.

Oscillators: Sinusoidal Oscillators, Conditions for oscillations, Phase – shift Oscillator, Wien Bridge Oscillator, L-C Oscillators (Hartley and Colpitts).

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

- Classify feedback amplifiers and oscillators (L1)
- Explain the concept of feedback and conditions for oscillations (L2)
- Apply the feedback amplifiers and oscillators to solve engineering problems (L3)
- Analyze feedback amplifiers and oscillator (L4)

UNIT - III (12 Hrs)

Large Signal Amplifiers (Power Amplifiers): Introduction, Classification, Class A large signal amplifiers, second – Harmonic Distortion, Higher – Order Harmonic Generations, Transformer Coupled Class A Audio Power Amplifier, Efficiency of Class A, Class B, Class AB Amplifiers, Distortion in Power Amplifiers, Class C Power Amplifier.

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

- Classify the large signal amplifiers (L1)
- Explain the operation of different types of large signal amplifiers (L2)
- Apply large signal amplifiers in a given engineering situation (L3)
- Analyze harmonic distortion in large signal amplifiers (L4)

UNIT - IV (12 Hrs)

Linear Integrated Circuits Operational Amplifier: Introduction, Block diagram of Op-Amp, Characteristics and Equivalent circuits of an ideal op-amp, 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 the unit, students should be able to

- Understand different Offsets present in Op amp & nullification circuits. (L1)
- Examine performance of Op-Amp in open loop and closed configurations. (L2)
- Analyse emitter-coupled differential amplifier. (L3)
- Compare ideal and practical Op-Amps. (L5)

UNIT-V (12 Hrs)

Applications of Linear Integrated Circuits: Adder, Integrator, Differentiator, Difference amplifier and Instrumentation amplifier, Converters: Current to voltage and voltage to current

converters, Active Filters: First order filters, second order low pass, high pass, band pass and band reject filters.

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 the unit, students should be able to

- Understand various applications of Linear ICs (L1)
- Explain operation of Op-Amp in various applications, Timer, Fixed voltage regulators (L2)
- Apply linear ICs in a given engineering situation (L3)

TEXTBOOKS:

1. "Electronic Devices and Circuits", Millman, Halkias and Jit, McGraw Hill Education (India) Private Ltd., 4th Edition, 2015.
2. "Electronic Devices and Circuits", Salivahanan and N. Suresh Kumar, McGraw Hill Education (India) Private Ltd., 4th Edition, 2017.
3. "Op-Amps & Linear ICs", Ramakanth A. Gayakwad, Pearson, 4th Edition, 2017.

REFERENCE BOOKS:

1. "Pulse, Digital and Switching Waveforms", Millman and Taub, Tata McGraw-Hill Education, 3rd Edition, 2011.
2. "Integrated Electronics", J. Milliman, C. C. Halkias and Chetan Parikh, McGraw Hill, 2nd Edition, 2010.
3. "Electronic Devices and Circuits", David A. Bell, Oxford Press, 5th Edition, 2008.
4. "Linear Integrated Circuits", D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition, 2003.

Course Code	ELECTRICAL MACHINES - II		L	T	P	C
21A020407			3	0	0	3
Pre-requisite	Electrical Machines - I	Semester	IV			

COURSE OBJECTIVES:

- Understand the fundamentals of AC machines, know equivalent circuit performance characteristics.
- Understand the methods of starting of Induction motors.
- Understand the methods of starting of Synchronous motors.
- Understand the parallel operation of Alternators.

COURSE OUTCOMES:

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

CO1: Understand the basics of ac machine windings, construction, principle of working, equivalent circuit of induction and synchronous machines.

CO2: Analyze the phasor diagrams of induction and synchronous machine, parallel operation of alternators, synchronization and load division of synchronous generators.

CO3: Analyze the various methods of starting in single phase induction machines

CO4: Apply the concepts to determine V and inverted V curves and power circles of synchronous motor.

CO5: Analyze the various methods of starting in both induction and synchronous machines.

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 Hrs)

Fundamentals of AC machine windings: Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factors.

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

- Understand the fundamentals of various parts used, different types of windings, distribution factor, Air-gap MMF distribution, constant and pulsating magnetic fields, addition of pulsating magnetic fields and revolving magnetic field. (L2)

- Analyze Magnetic and pulsating fields produced by spatially displaced windings and when the windings are spatially shifted by an angle. (L4)
- Apply above concepts to solve numerical problems. (L4)

UNIT–II (12 Hrs)

Induction Machines: Operating principle, Construction, Types (squirrel cage and slip-ring), Starting and Maximum Torque, Equivalent circuit, Phasor Diagram, Torque-Slip Characteristics, power flow in induction machines, Losses and Efficiency, No load and blocked rotor test, Circle diagram-performance characteristics, Numerical problems. Methods of starting, braking and speed control for induction motors, Doubly-Fed Induction Machines, crawling and cogging.

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

- Understand the construction, types, equivalent circuit, torque slip characteristics and various losses present in an induction machine. (L2)
- Analyze the phasor diagram, efficiency, starting and maximum torque, effect of parameter variation on torque speed characteristics (L4)
- Apply above concepts to solve numerical problems. (L4)

UNIT–III (12 Hrs)

Single-phase induction motors: Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and its applications, capacitor start and run single phase motors, reluctance single phase motors, stepper motors, BLDC motors.

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

- Understand induction generator operation, self-excitation, doubly fed induction machines, various methods of starting, braking and speed control of induction motors. (L2)
- Understand the constructional features, principle involved, equivalent circuit of single-phase induction motor and various starting methods and its applications. (L2)
- Apply above concepts to solve numerical problems. (L4)

UNIT–IV (12 Hrs)

Synchronous generators: Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation- EMF, MMF, ZPF and ASA methods. Operating characteristics of synchronous machines, Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division

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

- Understand the constructional features, emf generated, equivalent circuit, armature reaction, voltage regulation, characteristics, two reaction theory of synchronous machine. (L2)

- Analyze the phasor diagrams, parallel operation of alternators, synchronization and load division of synchronous generators. (L4)
- Apply above concepts to solve numerical problems. (L4)

UNIT–V (12 Hrs)

Synchronous motors: Principle of operation, methods of starting, Phasor diagram of synchronous motor, variation of current and power factor with excitation, Predetermination of V and inverted V curves, Hunting and use of damper bars, Synchronous condenser and power factor correction, Excitation and power circles.

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

- Understand the principle of operation, methods of starting, concept of hunting, synchronous condenser and power factor correction of synchronous motors. (L2)
- Analyze the phasor diagram, determination of V and inverted V curves and power circles of synchronous motor. (L4)
- Apply above concepts to solve numerical problems. (L4)

TEXTBOOKS:

1. "Electric Machinery", A. E. Fitzgerald and C. Kingsley, McGraw Hill Education, 2013.
2. "Electrical Machinery", P. S. Bimbhra, Khanna Publishers, 2011.

REFERENCE BOOKS:

1. "Performance and design of AC machines", M. G. Say, CBS Publishers, 2002.
2. "Electric Machines", I. J. Nagrath and D. P. Kothari, McGraw Hill Education, 2010.
3. "Alternating current machines", A. S. Langsdorf, McGraw Hill Education, 1984.
4. "Principles of Electric Machines and Power Electronics", P. C. Sen, John Wiley & Sons, 2007.

Course Code	CONTROL SYSTEMS AND ENGINEERING		L	T	P	C
21A020408			3	0	0	3
Pre-requisite	Complex Variables and Transforms	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 concepts of control systems classification, feedback effect, mathematical modelling and apply the concepts of Block diagram reduction, Signal flow graph method

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

CO3: State the 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 and 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	-	-	-	-	-	-	-	-	-	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)

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. Principle of operation of DC and AC Servo motor, Transfer function of DC servo motor - AC servo motor, Synchros

***Learning Outcomes*:** At the end of the unit, the student will 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 (L4)

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

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

UNIT–III (12 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

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

UNIT–IV (12 Hrs)

Frequency Response Analysis: Introduction, Frequency domain specifications-Bode Diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Stability Analysis from Bode Plots. Polar Plots-Nyquist Plots- Phase margin and Gain Margin-Stability Analysis. Compensation techniques – Lag, Lead, Lag-Lead Compensator design in frequency Domain.

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

- Evaluate the frequency domain specifications from Bode, Polar and Nyquist plots(L5)
- Design Compensators for various systems(L5)
- Deducing transfer functions from Bode Plots(L3)
- 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, Duality between 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" 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. "Feedback and Control Systems", Joseph J Distefano III, Allen R Stubberud & Ivan J Williams, Schaum's outlines, 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	ELECTRICAL MACHINES-II LAB		L	T	P	C
21A020409			0	0	3	1.5
Pre-requisite	Electrical Machines - I	Semester	IV			

COURSE OBJECTIVES:

- To experiment in detail on Induction Motors.
- To experiment in detail on Synchronous Motors.

COURSE OUTCOMES:

After completion of the course the student will be able to

CO1: Analyze and apply load test, no-load and blocked-rotor tests for construction of circle diagram and equivalent circuit determination in a single-phase induction motor.

CO2: Predetermine regulation of a three-phase alternator by synchronous impedance & m.m.f methods.

CO3: Predetermine the regulation of Alternator by Zero Power Factor method Xd and Xq determination of salient pole synchronous machine.

CO4: Evaluate and analyze V and inverted V curves of 3 phase synchronous motor

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. No-load & Blocked-rotor tests on Squirrel cage Induction motor.
2. Load test on three phase slip ring Induction motor.
3. Speed control of three phase induction motor
4. Rotor resistance starter for slip ring induction motor
5. Load test on single phase induction motor.
6. Determination of Equivalent circuit of a single phase induction motor.
7. Predetermination of Regulation of a three phase alternator by synchronous impedance & m.m.f methods
8. Predetermination of Regulation of three-phase alternator by Z.P.F. method.
9. Determination of Xd and Xq of a salient pole synchronous machine.
10. V and inverted V curves of a 3-phase synchronous motor.

Note: All the ten experiments are required to be performed

REFERENCE BOOKS:

1. "Laboratory Manual for Electrical Machines" D. P. Kothari and B. S. Umre, I.K International Publishing House Pvt. Ltd, 2017.
2. "A Laboratory Course in Electrical Machines", D. R. Kohli and S.K. Jain, NEM Chand & Bros.

Course Code	CONTROL SYSTEMS AND SIMULATION LAB		L	T	P	C
21A020410			0	0	3	1.5
Pre-requisite	NIL	Semester	IV			

COURSE OBJECTIVES:

- Determination of transfer functions of various systems and control of it by different methodologies.
- To provide knowledge in the analysis and design of controllers and compensators.
- The characteristics of servo mechanisms which are helpful in automatic control systems.
- To know the stability analysis using MATLAB.

COURSE OUTCOMES:

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

CO1: Get the knowledge of feedback control and transfer function of DC servo motor.

CO2: Model the systems and able to design the controllers and compensators.

CO3: Get the knowledge about the effect of poles and zeros location on transient and Steady state behaviour of second order systems and can implement them to practical Systems and MATLAB

CO4: Determine the performance and time domain specifications of first and second order Systems.

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	3	2
CO2	3	2	1	2	2	2	-	-	-	-	-	1	3	2
CO3	3	2	1	2	2	1	-	-	-	-	-	1	3	2
CO4	3	2	1	2	2	1	-	-	-	-	-	1	3	2

LIST OF EXPERIMENTS:

1. Time response of Second order system
2. Characteristics of Synchros
3. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions and application of speed control of motor.
4. Effect of feedback on DC servo motor
5. Transfer function of DC Machine
6. Effect of P, PD, PI, PID Controller on a second order system
7. Lag and lead compensation – Magnitude and phase plot
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor

Note: Any Eight of the above experiments are to be performed:

LIST OF SIMULATION EXPERIMENTS:

1. PSPICE simulation of Op-Amp based Integrator and Differentiator circuits.
2. Linear system analysis (Time domain analysis, Error analysis) using MATLAB.
3. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using MATLAB
4. State space model for classical transfer function using MATLAB – Verification

Note: Any two simulation experiments are to be performed:

REFERENCE BOOKS:

1. "Simulation of Electrical and electronics Circuits using PSPICE", M. H. Rashid, M/s PHI Publications.
2. "PSPICE A/D user's manual", Microsim, USA.
3. "PSPICE reference guide", Microsim, USA.
4. "MATLAB and its Tool Books user's manual", MathWorks, USA

Course Code	ANALOG ELECTRONIC CIRCUITS LAB		L	T	P	C
21A020411			0	0	3	1.5
Pre-requisite	NIL	Semester	IV			

COURSE OBJECTIVES:

- List various types of feedback amplifiers, oscillators and large signal Amplifiers.
- Explain the operation of various electronic circuits and linear ICs.
- Apply various types of electronic circuits to solve engineering problems
- Analyse various electronic circuits and regulated power supplies for proper understanding
- Justify choice of transistor configuration in a cascade amplifier.
- Design electronic circuits for a given specification.

COURSE OUTCOMES:

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

CO1: List various types of feedback amplifiers, oscillators and large signal amplifiers
CO2: Explain the operation of various electronic circuits and linear ICs
CO3: Apply various types of electronic circuits to solve engineering problems
CO4: Analyze various electronic circuits and regulated power supplies for proper understanding
CO5: Justify choice of transistor configuration in a cascade amplifier

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

LIST OF HARDWARE EXPERIMENTS:

1. Design two stage RC coupled amplifier for given specifications. Determine Gain and Bandwidth from its frequency response curve.
2. Design Darlington amplifier. Determine Gain and Bandwidth from its frequency response curve.
3. Design voltage series feedback amplifier for the given specifications. Determine the effect of feedback on the frequency response of a voltage series feedback amplifier.
4. Design RC Phase shift oscillator and Wien bridge oscillator for the given specifications. Determine the frequency of oscillation.
5. Analyze a Class B complementary symmetry power amplifier and observe the waveforms with and without cross-over distortion. Determine maximum output power and efficiency.

6. Design inverting and non-inverting amplifiers for the given specifications using OP-AMP and verify the same experimentally.
7. Design practical differentiator and integrator circuits using OP-AMP for the given specifications and verify the same practically.
8. Design a second order low pass and high pass active filters using OP-AMP using the given specifications. Verify them practically.
9. Design an astable multi-vibrator circuit for the given specifications using 555 timer. Plot output waveforms.
10. Design a mono stable multi-vibrator circuit for the given specifications using 555 timer. Plot output waveforms.

Note: Any eight of the above hardware experiments should be performed.

LIST OF SIMULATION EXPERIMENTS:

1. Simulate two stage RC coupled amplifier for given specifications. Determine Gain and Bandwidth from its frequency response curve.
2. Simulate Darlington amplifier. Determine Gain and Bandwidth from its frequency response curve.
3. Simulate voltage series feedback amplifier for the given specifications. Determine the effect of feedback on the frequency response of a voltage series feedback amplifier.
4. Simulate RC Phase shift oscillator and Wien bridge oscillator for the given specifications. Determine the frequency of oscillation.

Note: Any 2 of the above experiments with Multisim / PSPICE or equivalent software

TEXTBOOKS:

1. "Electronic Devices and Circuits", Millman, Halkias and Jit, McGraw Hill Education (India) Private Ltd., 4th Edition, 2015.
2. "Electronic Devices and Circuits", Salivahanan and N. Suresh Kumar, McGraw Hill Education (India) Private Ltd., 4th Edition, 2017.
3. "Op-Amps & Linear ICs", Ramakanth A. Gayakwad, Pearson, 4th Edition, 2017.

REFERENCE BOOKS:

1. "Pulse, Digital and Switching Waveforms", Millman and Taub, Tata McGraw-Hill Education, 3rd Edition, 2011.
2. "Integrated Electronics", J. Milliman, C. C. Halkias and Chetan Parikh, McGraw Hill, 2nd Edition, 2010.
3. "Electronic Devices and Circuits", David A. Bell, Oxford Press, 5th Edition, 2008.

Course Code	ELECTRICAL ENGINEERING WORKSHOP-I		L	T	P	C
21A020701			1	0	2	2
Pre-requisite	Fundamentals of Electrical Circuits	Semester	IV			

COURSE OBJECTIVES:

- To know about different tools, abbreviations and symbols in Electrical Engineering
- To learn about types of measuring instruments to measure electrical quantities
- To gain knowledge on different types of earthing and earth resistance
- To study different types of wiring

COURSE OUTCOMES:

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

CO1: Demonstrate knowledge on different tools used to service the electrical appliances.
CO2: Analyze and understand the various lamps and load connections.
CO3: Understand the importance of earthing in valuable load appliances.
CO4: Demonstrate how to trouble shoot the electrical domestic appliances.
CO5: Perform the soldering practices.

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

LIST OF EXPERIMENTS:

Task 1:
Introduction to Electrical tools, symbols and abbreviations in Electrical Engineering

Task 2:
Type of Cables and Joints (T and straight joints)

Task 3:
Lamp Connections (Fluorescent tubes and Special lamp connections)

Task 4:
Residential wiring (With Energy meter, Fuses, Switches, Indicators, Lamps)

Task 5:
Trouble shooting of electrical equipments (fan, iron box, mixer-grinder)

Task 6:
Earthing: Study of earthing and measurement of earth resistance

Task 7:
Wiring Practices for various motors and loads

Task 8:
Experimental study of Solar PV system

Task 9:
Basics of Electronic components, Soldering practices and PCB's design

Task 10:
Power semiconductor devises: Terminal identification, Testing and Description

Task 11:
FIRST AID: Know the procedures of first aid for shock treatment to an electrocuted person, Understand and demonstrate types of fire extinguishers.

REFERENCE BOOKS:

1. "Electrical work shop", R. P. Singh, I.K. International Publishing House Pvt. Limited, 2005
2. "Electrical Design Estimating and Costing", K.B. RAINA & S. K. BHATTA CHARYA
3. "Residential and Commercial Industrial Electrical Systems Vol.2", Joshi, TMH
4. "Residential and Commercial Industrial Electrical systems Vol.3", by Joshi, TMH
5. "Industrial Safety management", Deshmukh, TMH
6. "Operation & Maintenance of Electrical Machines Vol – I", B V S Rao
7. "Preventive Maintenance", C.J. Hubert

Course Code	POWER SYSTEM ARCHITECTURE		L	T	P	C
21A020412			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- Operation of conventional power generating systems and their components.
- The role of non-conventional power generating systems and their operation and economic aspects.
- Calculation of different transmission line parameters and their use.
- Modeling of transmission line and evaluation of constants.

COURSE OUTCOMES:

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

CO1: Remember and understand the concepts of conventional and nonconventional power generating systems. **(K2)**

CO2: Apply the economic aspects to the power generating systems. **(K3)**

CO3: Analyze the transmission lines and obtain the transmission line parameters and constants. **(K4)**

CO4: Design and develop the schemes to improve the generation and capability of transmission line to meet the day-to-day power requirements.**(K5)**

CO5: Describe the design features of electrical distribution systems. **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Conventional Power Generating Systems:

Thermal Power: Block Diagram of Thermal Power Station (TPS), Brief Description of TPSComponents **Hydro Power:** Selection of Site, Classification, Layout, and Description of Main Components. **Nuclear Power:** Nuclear Fission and Chain Reaction-Principle of Operation of Nuclear Reactor.- Reactor Components: Moderators, Control Rods, Reflectors, and Coolants. Radiation Hazards: Shielding and Safety Precautions -Types of Nuclear Reactors.

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

- Understand the concept of layout and design aspects of Thermal, Hydro and Nuclear PowerPlants.(L2)
- Obtain the principle of operation of Thermal, Hydro and Nuclear Power Plants.(L2)

UNIT–II (9 Hrs)

Non- Conventional Power Generating Systems:

Solar Power Generation: Role and Potential of Solar Energy Options, Principles of Solar

Radiation, Solar Energy Collectors, Different Methods of Energy Storage – PV Cell- V-I Characteristics.

Wind Power Generation: Role and potential of Wind Energy Options, Horizontal and Vertical AxisWind Mills- Performance Characteristics-Pitch & Yaw Controls – Economic Aspects.

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

- Understand the concept of design of Solar, Wind Power generation.(L2)
- Obtain the principle of operation of Solar, Wind Power generation.(L3)

UNIT–III (9 Hrs)

Transmission Line Parameters: Types of conductors - calculation of resistance for solid conductors, Bundle conductors, Skin effect, Proximity effect, the concept of GMR & GMD-Transposition of Power lines- Calculation of inductance for single phase and three phases, single and double circuit lines, symmetrical and asymmetrical conductor configurations with and without transposition. Calculation of capacitance for 2-wire and 3-wire systems, the effect of ground on capacitance, capacitance calculations for symmetrical and asymmetrical single and three phase, singleand double circuit lines, Numerical Problems.

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

- Obtain the transmission line parameters for different types of lines and also for symmetrical and asymmetrical single and three-phase, single and double circuit lines. (L3)

UNIT–IV (9 Hrs)

Modeling of Transmission Lines, Insulators and Cables: Classification of Transmission Lines - Short, medium and long lines and their models - representations - Nominal-T, Nominal-π and A, B, C, D Constants. Long Transmission Line-Rigorous Solution, Numerical Problems – Surge Impedance and surge Impedance loading - Types of System Transients - Travelling or Propagation of Surges -– Ferranti effect, Charging current, Types of Insulators, String efficiency, and Methods for improvement, – Voltage Distribution, Calculation of string efficiency, Corona - Description of the phenomenon, factors affecting corona, Sag and Tension Calculations with equal and unequal heights of towers, Effect of Wind and Ice on the weight of Conductor, Stringing chart and sag template and its applications. Types of Cables, Construction, Types of Insulating materials, Numerical Problems

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

- Obtain the classification of transmission lines and A,B,C,D constants for transmission lines, need of shunt compensation.(L3)
- Understand the concept of Corona and SAG equal and unequal levels.(L2)

UNIT–V (9 Hrs)

General Aspects of Distribution Systems: Classification of Distribution Systems -Comparison of DC & AC and Under-Ground & Over-Head Distribution Systems. Voltage Drop and power loss in D.C Distributors for the following cases: Radial D.C Distributors fed at one end and at ends (equal/unequal Voltages), Uniform loading and Ring Main Distributor.

Substations: Location of Substations: Rating of distribution substations, 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 – Gas Insulated Substation (GIS).

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

- Compare DC vs AC and under-ground vs over - head distribution systems, types of distribution systems (L3)
- Get the knowledge about design of distribution feeders, voltage drop and power loss in A.C. distributors (L2)
- Learn substation and types of substations, various arrangements in substations (L3)

TEXTBOOKS:

1. "A Text Book on Power System Engineering", M. L. Soni, P. V. Gupta, U. S. Bhatnagar and A. Chakraborti, Dhanpat Rai& Co. Pvt. Ltd., 1999.
2. "Electric Power Generation Distribution and Utilization", C.L Wadhwa, New Age International (P) Ltd., 2005.
3. "Non Conventional Energy Sources", G.D. Rai, Khanna Publishers, 2000.

REFERENCE BOOKS:

1. "Renewable Energy Resources", John Twidell and Tony Weir, Taylor and Francis Group, 2nd Edition, 2006.
2. "Electrical Power Generation, Transmission and Distribution", S. N. Singh., PHI, 2003.
3. "Principles of Power Systems", V.K. Mehta and Rohit Mehta, S. Chand & Company Ltd., New Delhi 2004.
4. "Wind Electrical Systems", S. N. Bhadra, D. Kastha & S. Banerjee, Oxford University Press, 2013.

Course Code	POWER ELECTRONICS		L	T	P	C
21A020413			3	0	0	3
Pre-requisite	Electronic Devices & Circuits	Semester	V			

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 basic 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, Voltage controllers and Cyclo Converters.**(K2)**

CO5: Apply all the above concepts to solve various numerical problems solving **(K3)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Power Semiconductor Devices: Power Diode, Silicon Control Rectifier(SCR), BJT, MOSFET, IGBT: I-V Characteristics; Dynamic Characteristics of an SCR, 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 semiconductor devices. (L2)
- Importance of drive circuit for MOSFET, IGBT, and GTO(L2)

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 rectifierwith R-load and highly inductive load; Input current wave shape, power factor, and effect of source inductance; Dual Converter -Numerical problems.

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

- Derivation of expressions of different configurations of rectifiers. (L2)
- Calculate the Average, R.M.S values of Voltages and Currents(L3)
- Draw its output voltage and current waveforms. (L2)

UNIT – III (9 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 the duty cycle.(L2)
- Analysis of waveforms at steady state of power circuit(L3)
- Derivation of an average output voltage of DC-DC converter.(L3)

UNIT – IV (9 Hrs)

Inverters: Single phase Voltage Source inverters – operating principle - steady state analysis, Simple forced commutation circuits for bridge inverters –Voltage control techniques for invertersand Pulse width modulation techniques, single-phase current source inverters with ideal switches,basic series inverters, single-phase parallel inverter – basic principle of operation only, Three phase bridge inverters (VSI) – 180-degree mode – 120-degree mode of operation-Numerical problems.

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.(L3)
- Derivation of average and RMS output voltage of DC-AC converter.(L2)

UNIT – V (9 Hrs)

AC Voltage Controllers & Cyclo Converters: AC voltage controllers – Principle of phase control – Principle of integral cycle control - Single phase two SCRs in anti-parallel – With Rand RL loads – modes of operation of TRIAC – TRIAC with R and RL loads – RMS load voltage, current and power factor - waveforms – Numerical problems.

Cyclo Converters - Midpoint and Bridge connections – Single-phase to single-phase step-up and step-down Cyclo Converters with Resistive and inductive load, Principle of operation, Waveforms, output voltage equation.

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 principle operation of voltage and frequency converter.(L3)
- Analysis waveforms of ac voltage converter and Cyclo converter.(L4)

TEXTBOOKS:

1. "Power Electronics: Circuits, Devices, and Applications", M. H. Rashid, PrenticeHall 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. "PowerElectronics", P. C. Sen, Tata Mc Graw-Hill Education, 1987.
6. "Power Electronic Control of Alternating Current Motors", J. M. D. Murphy

Course Code	ELECTRICAL MEASUREMENTS		L	T	P	C
21A020414			3	0	0	3
Pre-requisite	Fundamentals of Electrical Circuits	Semester	V			

COURSE OBJECTIVES:

- To understand the basic principles of different types of electrical instruments for the measurement of voltage, current.
- To understand the basic principles of different types of electrical instruments for the measurement of power factor, power and energy.
- To measure RLC parameters using bridge principles.
- To measure Voltages and Currents for High & Low Ratings.
- To understand the principle of magnetic measurements, working of CRO and its applications.

COURSE OUTCOMES:

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

CO1: Understand the working of various instruments used for the measurement of various electrical engineering parameters like voltage, current. **(K2)**

CO2: Understand the working of various instruments used for the measurement of various electrical engineering parameters like power, power factor & Energy. **(K2)**

CO3: Measure RLC parameters using bridge principles. **(K4)**

CO4: Measure Voltages and Currents for High & Low Ratings with suitable equipment and instruments. **(K3)**

CO5: Understand principle of magnetic measurements & working of CRO and Digital meters applications. **(K3)**

CO-PO MAPPING:

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

UNIT–I (9 Hrs)

Measuring Instruments: Classification – Ammeters and Voltmeters – PMMC, Dynamometer, Moving Iron Types – Expression for the Deflecting Torque and Control Torque – Errors and their Compensation, Extension of range – Numerical examples.

Learning Outcomes: At the end of the unit, the student will be able to

- Understand the operation of different instruments. (L2)
- Know the different types of errors and their compensation. (L4)
- Distinguish between MC and MI type of instruments(L3)
- Know how control of torque is required in measurements(L4)

UNIT–II (9 Hrs)

Measurement of Power, Power Factor And Energy: Single Phase Dynamometer Wattmeter, LPF and UPF, Double Element and Three Elements, Expression for Deflecting and Control Torques;

P.F. Meters: Dynamometer and Moving Iron Type – 1-ph and 3-ph Power factor Meters.

Single Phase Induction Type Energy Meter – Driving and Braking Torques – Errors and their Compensation, Three Phase Energy Meter – Numerical examples

Learning Outcomes: At the end of the unit, the student will be able to

- Understand the working principles and construction of different types of Energy meters(L2)
- Calculate the different parameters of the meters(L2)
- Distinguish between low and high power factor ranges in watt meters(L3)
- Know about occurrence of errors and need for compensation for precise and accurate measurement(L4)
- Distinguish between 3-ϕ power factor meters and Energy meters(L3)

UNIT–III (9 Hrs)

D.C & A.C Bridges: Method of Measuring Low, Medium and High Resistances – Sensitivity of Whetstone's Bridge Kelvin's Double Bridge for Measuring Low Resistance, Measurement of High Resistance – Loss of Charge Method. Measurement of Inductance - Maxwell's Bridge, Anderson's Bridge. Measurement of capacitance and loss angle – DeSauty Bridge. Wien's Bridge – Schering Bridge – Numerical Examples.

Learning Outcomes: At the end of the unit, the student will be able to

- Understand the bridge configurations and their applications for various ranges of resistance measurement(L2)
- Compute the unknown parameters of Inductance using the bridges(L3)
- Compute the unknown parameters of Capacitance using the bridges(L3)
- Be able to select appropriate bridge configuration for measurement of R,L and C(L3)

UNIT–IV (9 Hrs)

Instrument Transformers & Potentiometers: Current Transformers and Potential Transformers – Ratio and Phase Angle Errors – Methods for Reduction of Errors-Design Considerations.

DC Potentiometers: Principle and Operation of D.C. Crompton's Potentiometer –Standardization – Measurement of unknown Resistance, Currents and Voltages. A.C. Potentiometers: Polar andCoordinate types- Standardization –Applications.

Learning Outcomes: At the end of the unit, the student will be able to

- Design the various voltage and current measuring instruments.(L5)

- Distinguish between CTs and PTs.(L4)
- Distinguish between DC and AC potentiometers.(L4)

UNIT–V (9 Hrs)

Magnetic Measurements &CRO: Determination of B-H Loop: Methods of Reversals - Six Point magnetic measurement Method A.C. Testing – Iron Loss of Bar Samples – Numerical Examples. Cathode Ray Oscilloscope- Cathode Ray Tube-Time Base Generator-Horizontal and Vertical Amplifiers – Applications of CRO – Measurement of Phase, Frequency, Current and Voltage- Lissajous Patterns

Learning Outcomes: At the end of the unit, the student will be able to

- Understand principle of magnetic measurements.(L2)
- Understand the operation of CRO and its parts.(L2)
- Know about various applications of CRO.(L2)
- Understand various Lissajous patterns.(L2)

TEXTBOOKS:

1. "Electrical & Electronic Measurement & Instruments", K. Sawhney, Dhanpat Rai & Co. Publications, 2007.
2. "Electrical Measurements and measuring Instruments", E. W. Golding and F.C. Widdis, Reem Publications, 5th Edition, 2011.

REFERENCE BOOKS:

1. "Electronic Instrumentation", H. S. Kalsi, Tata McGraw Hill, 3rd Edition, 2011.
2. "Electrical Measurements: Fundamentals, Concepts, Applications", M.U Reissland, New Age International (P) Limited, 2010.
3. "Electrical & Electronic Measurement & Instrumentation", R. K. Rajput, S. Chand & Co., 2nd Edition, 2013.

Course Code	DESIGN OF PHOTOVOLTAIC SYSTEMS		L	T	P	C
21A020415			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- To understand the Basics of Photovoltaic Cells.
- To understand the Energy Estimation and cost.
- To analyse of the Maximum PowerPoint Tracking.
- To analyze PV Interfacing.

COURSE OUTCOMES:

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

CO1: Understand the operation, characteristics and usage of basic power semiconductor devices **(K2)**

CO2: Understand the basic concepts of PV Cells.**(K2)**

CO3: Understand the concepts of Energy estimation and Sizing.**(K2)**

CO4: Understand the Design MPPT.**(K2)**

CO5: Analyze PV system along with its interfacing.**(K4)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

PV Cell: A historical perspective, PV cell characteristics and equivalent circuit, Model of PV cell, Short Circuit, Open Circuit and peak power parameters, Datasheet study, Cell efficiency, Effect of temperature, Temperature effect calculation example, Fill factor, PV cell simulation, Series and Parallel Interconnection.

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

- Determine electric field and potentials using Coulomb's law & Gauss law. (L3)
- Analyze Potential differences for different configurations. (L4)
- Classify static electric magnetic fields in different engineering situations. (L2)

UNIT – II (9 Hrs)

Energy Estimation and Sizing PV: Energy from Sun, insolation, and irradiance, insolation variation with time delay, Solar geometry, Insolation on a horizontal flat plate, Sunrise and sunset hour angles,

Energy plots in octave, atmospheric effects, air mass, Clearness index Sizing PV for applications without batteries, Examples, Batteries: Introduction, Capacity, C-rate, efficiency, energy and power densities, Battery selection, other energy storage methods, PV system design.

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

- Analyze the Concepts of Conduction and Convection currents. (L4)
- Understand the concept of capacitance for parallel plates, spherical & co-axial capacitors. (L3)
- Calculate Energy stored and energy density in a static electric field. (L3)

UNIT–III (9 Hrs)

Maximum Power Point Tracking: MPPT concept, the Input impedance of DC-DC converters - Boost converter, Buck converter, Buck-Boost converter, PV and DC-DC interface, Impedance control methods-voltage scaling, current scaling, Sampling method, Power slope method 1, Power slope method 2, Hill climbing method, Practical points - Housekeeping power supply.

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

- Analyze the Concepts of Magnetic field intensity by Biot-Savart Law & Ampere Law. (L4)
- Understand Maxwell's equations. (L2)
- Develop MFI due to an infinite sheet of current and a long filament carrying conductor in Different loops. (L3)

UNIT–IV (9 Hrs)

PV-Battery Interface: Direct PV-battery connection, Charge controller, Battery charger - Understanding current control, slope compensation, simulation of current control, Batteries in series - charge equalization, Batteries in parallel Peltier device – principle, Peltier element – datasheet, Peltier cooling, Thermal aspects- Conduction, Convection, A Peltier refrigeration example, Radiation and mass transport, Demo of Peltier cooling, PV and Water pumping.

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

- Understand scalar magnetic potential and vector magnetic potential and its applications. (L3)
- Calculate the magnetic forces and torque produced by currents in Magnetic Field. (L2)
- Calculate self and mutual Inductances. (L4)

UNIT–V (9 Hrs)

PV and Grid Interface: Grid connection principle, PV to grid topologies, 3ph d-q controlled grid connection- introduction, DQ-axis theory, AC to DC transformation, DC to AC transformation, Complete 3ph grid connection, 1ph d-q controlled grid connection, 3ph PV-Grid interface example, SVPWM – discrete implementation, analog implementation, Application of

integrated magnetics, LIFE CYCLE COSTING Growth models, examples, Annual payment and present worth factor.

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

- Acquire knowledge on time varying fields & Faraday's law for Electromagnetic induction (L3)
- Analyze the Concepts Maxwell's Equations in Different Forms. (L4)
- Understand the Concepts Calculation of Poynting vector & Theorem. (L3)
- Analyze the Concepts of Wave Theory (L4)

TEXTBOOKS:

1. "Design of Photovoltaic Systems", L. Umanand

REFERENCE BOOKS:

1. "Non-conventional energy sources", G. D. Rai

ONLINE LEARNING RESOURCES:

1. https://nptel.ac.in/courses/117108141

Course Code	PROGRAMMABLE LOGIC CONTROLLER AND APPLICATIONS		L	T	P	C
21A020416			3	1	0	3
Pre-requisite	Digital Electronic Circuits	Semester	V			

COURSE OBJECTIVES:

- PLC and its basics, architecture, connecting devices and programming
- Implementation of Ladder logic for various Industrial applications
- Explain PLC timers and counters for the control of industrial processes
- PLC logic and arithmetic operations

COURSE OUTCOMES:

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

CO1: Program a PLC for a given basic application.**(K2)**
CO2: Construct Ladder logic for various Industrial applications.**(K3)**
CO3: Illustrate the Various applications of PLC Functions.**(K2)**
CO4: Illustrate various applications of data handling functions.**(K2)**
CO5: Understand the Analog PLC operation. **(K2)**

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	3	2
CO2	2	1	1	-	-	-	-	-	-	-	-	1	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	-	3	2
CO4	2	1	1	-	-	-	-	-	-	-	-	1	3	2
CO5	3	2	1	2	-	-	-	-	-	-	-	1	3	2

UNIT – I (9 Hrs)

PLC Basics: PLC System, I/O Modules and Interfacing, CPU Processor, Programming Equipment, Programming Formats, Construction of PLC Ladder Diagrams, Devices Connected To I/O Modules.

PLC Programming: Input Instructions, Outputs, Operational Procedures, Programming Examples Using Contacts and Coils. Drill Press Operation.

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

- Understand the basic concepts of Programmable Logic Controllers (L2)
- Understand the Various PLC Instructions (L2)
- Understand the various Operational Procedures in PLC(L2)

UNIT – II (9 Hrs)

Digital Logic Gates, Programming in the Boolean algebra System, Conversion Examples. Ladder Diagrams for Process Control: Ladder Diagrams & Sequence Listings, Ladder Diagram

Construction and Flowchart for Spray Process System.

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

- Understand the Digital Logic Gates. (L2)
- Analyze the Digital Logic gates using Boolean algebra. (L4)
- Analyze the Ladder Diagrams & Sequence Listing .(L3)

UNIT – III (9 Hrs)

PLC Registers: Characteristics of Registers, Module Addressing, Holding Registers, Input Registers, Output Registers.

PLC Functions: Timer Functions & Industrial Applications, Counter Function & Industrial Applications, Arithmetic Functions, Number Comparison Functions, Number Conversion Functions.

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

- Understand the Various PLC Registers (L2)
- Analyze the various PLC Functions (L4)
- Analyze the Industrial applications with the various PLC Functions (L4)

UNIT – IV (9 Hrs)

Data Handling Functions: SKIP, Master Control Relay, Jump, Move, FIFO, FAL, ONS, CLR & Sweep Functions and Their Applications. Bit Pattern and Changing a Bit Shift Register, Sequence Functions and Applications, Controlling of Two-Axis Robots With PLC, Matrix Functions.

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

- Illustrate various Data Handling functions in PLC (L2)
- Understand the Sequencer functions in PLC (L2)
- Analyze the control of Two axis Robot with PLC (L3)

UNIT – V (9 Hrs)

Analog PLC Operation, Types of PLC Analog Modules and Systems, PLC Analog Signal Processing, BCD or Multibit data Processing. PID Modules, PID Tuning, Typical PIDFunctions, PLC Installation, Trouble shooting and Maintenance

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

- Understand the Analog PLC Operation (L2)
- Understand the Typical PID Functions (L2)

TEXTBOOKS:

1. "Programmable Logic Controllers - Principles and Applications", John W. Webb & Ronald A. Reiss, ELSEVIER Ltd., 5th Edition, 2009.

2. "Programmable Logic Controllers", William Bolton, Newnes, Elsevier Ltd., 5th Edition, 2009.

REFERENCE BOOKS:

1. "Programmable Logic Controllers: An Emphasis on design & application", Kelvin T. Erickson, Dogwood Valley Press, 2011.

Course Code	NEURAL NETWORKS & FUZZY LOGIC		L	T	P	C
21A020417			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- Importance of AI techniques in engineering applications
- Artificial Neural network and Biological Neural Network concepts
- ANN approach in various Electrical Engineering problems
- Fuzzy Logic and Its use in various Electrical Engineering Applications

COURSE OUTCOMES:

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

CO1: Approaches and architectures of Artificial Intelligence. **(K3)**
CO2: Analyze Artificial Neural Networks terminologies and techniques **(K2)**
CO3: Development of Fuzzy Logic concept **(K2)**
CO4: Use of Fuzzy Logic for motor control and AVR operation **(K2)**
CO5: Use of Fuzzy Logic controller in an 18 bus bar system **(K2)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction to Artificial Intelligence: Introduction and motivation – Approaches to AI – Architectures of AI – Symbolic Reasoning System – Rule based Systems - Knowledge Representation – Expert Systems.

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

- Determine electric field and potentials using Coulomb's law & Gauss law. (L3)
- Analyze Potential differences for different configurations. (L4)
- Classify static electric magnetic fields in different engineering situations. (L2)
- Determine the Concepts of Electric dipole, Electrostatic Energy and Energy density. (L3)

UNIT – II (9 Hrs)

Artificial Neural Networks: Basics of ANN - Comparison between Artificial and Biological Neural Networks – Basic Building Blocks of ANN – Artificial Neural Network Terminologies – McCulloch Pitts Neuron Model – Learning Rules – ADALINE and MADALINE Models –

Perceptron Networks – Back Propagation Neural Networks –Associative Memories.

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

- Analyze the Concepts of Conduction and Convection currents. (L4)
- Understand the concept of capacitance for parallel plates, spherical & co-axial capacitors.(L3)
- Calculate Energy stored and energy density in a static electric field. (L3)

UNIT – III (9 Hrs)

ANN Applications to Electrical Systems: ANN approach to Electrical Load Forecasting Problem – System Identification – ControlSystems – Pattern Recognition.

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

- Analyze the Concepts of Magnetic field intensity using Biot-Savart Law & Ampere Law.(L4)
- Understand Maxwell's equations. (L2)
- Develop MFI due to an infinite sheet of current and a long filament carrying conductor in different loops. (L3)

UNIT – IV (9 Hrs)

Fuzzy Logic: Classical Sets – Fuzzy Sets – Fuzzy Properties and Operations – Fuzzy Logic System – Fuzzification – Defuzzification – Membership Functions – Fuzzy Rule base – Fuzzy Logic Controller Design.

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

- Understand scalar magnetic potential and vector magnetic potential and its applications.(L3)
- Calculate the magnetic forces and torque produced by currents in Magnetic Field. (L2)
- Calculate self and mutual Inductances. (L4)

UNIT – V (9 Hrs)

Fuzzy Logic Applications to Electrical Systems: Fuzzy Logic Implementation for Induction Motor Control – Switched Reluctance Motor Control –Fuzzy Excitation Control Systems in Automatic Voltage Regulator - Fuzzy Logic Controller in an 18 Bus Bar System.

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

- Acquire knowledge on time varying fields & Faraday's law for Electromagnetic induction (L3)
- Analyze the Concepts Maxwell's Equations in Different Forms. (L4)
- Understand the Concepts Calculation of Poynting vector & Theorem. (L3)
- Analyze the Concepts of wave theory (L4)

TEXTBOOKS:

1. "Introduction to Neural Networks using MATLAB", S. N. Sivanandam, S. Sumathi and S. N. Deepa, McGraw Hill Edition, 2006.
2. "Fuzzy Logic with Engineering Applications", Timothy J. Ross, WILEY India Edition, 3rd Edition, 2012

REFERENCE BOOKS:

1. "Introduction to Fuzzy Logic using MATLAB", S. N. Sivanandam, S. Sumathi and S. N. Deepa, Springer International Edition, 2013.
2. "Intelligent System – Modeling, Optimization & Control", Yung C. Shin and Chengying Xu, CRC Press, 2009

Course Code	POWER ELECTRONICS LAB		L	T	P	C
21A020418			0	0	3	1.5
Pre-requisite	Electronic Devices & Circuits Lab	Semester	V			

COURSE OBJECTIVES:

- Understand and analyze various characteristics of power electronic devices with gate firing circuits and forced commutation techniques.
- Analyze the operation of single-phase half & fully-controlled converters and inverters with different types of loads.
- Analyze the operation of DC-DC converters, single-phase AC Voltage controllers, and cyclo converters with different loads.

COURSE OUTCOMES:

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

CO1: Understand and analyze various characteristics of power electronic devices with gate firing circuits and forced commutation techniques. **(K3)**

CO2: Analyze the operation of single-phase half &fully-controlled converters and inverters with different types of loads. **(K4)**

CO3: Analyze the operation of DC-DC converters. **(K4)**

CO4: Analyze the operation of single-phase AC voltage controllers. **(K4)**

CO5: Analyze the operation of Cyclo converters. **(K4)**

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. Study of Characteristics of SCR, MOSFET & IGBT
2. Gate firing circuits for SCRs R triggering (b) R-C triggering
3. Single Phase AC Voltage Controller with R and RL Loads
4. Single Phase fully controlled bridge converter with R and RL loads
5. Forced Commutation circuits (Class A, Class B, Class C, Class D & Class E)
6. DC Jones chopper with R and RL Loads
7. Single Phase Parallel, inverter with R and RL loads
8. Single Phase Cycloconverter with R and RL loads

9. Single Phase half controlled converter with R load
10. Three Phase half controlled bridge converter with R-load
11. Single Phase series inverter with R and RL loads
12. Single Phase Bridge converter with R and RL loads
13. Single Phase dual converter with RL loads.

NOTE: Any ten experiments from the above list should be performed.

REFERENCE BOOKS:

1. "Power Electronics Laboratory: Theory, Practice and Organization (Narosa series in Power and Energy Systems)", O.P. Arora, Alpha Science International Ltd., 2007.
2. "Electric and Electronic circuits using PSPICE", M. H. Rashid, M/s PHI Publications.

ONLINE LEARNING RESOURCES:

1. http://vlabs.iitb.ac.in/vlabs-ev/labs/mit_bootcamp/power_electronics/labs/index.php

Course Code	ELECTRICAL MEASUREMENTS LAB		L	T	P	C
21A020419			0	0	3	1.5
Pre-requisite	Electrical Circuit Analysis	Semester	V			

COURSE OBJECTIVES:

- Calibration of various electrical measuring instruments
- Accurate determination of inductance and capacitance using AC Bridges
- Measurement of coefficient of coupling between two coupled coils
- Measurement of resistance for different range of resistors using bridges

COURSE OUTCOMES:

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

CO1: Calibrate various electrical measuring instruments **(K4)**
CO2: Accurately determine the values of inductance and capacitance using AC bridges.**(K3)**
CO3: Compute the coefficient of coupling between two coupled coils. **(K3)**
CO4: Accurately determine the values of very low resistances. **(K3)**
CO5: Measure reactive power in 3-phase circuit using single wattmeter. **(K4)**

CO-PO MAPPING:

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

LIST OF EXPERIMENTS:

1. Calibration and Testing of single phase energy Meter
2. Calibration of dynamometer power factor meter
3. Crompton D.C. Potentiometer – Calibration of PMMC ammeter and voltmeter
4. Kelvin's double Bridge – Measurement of low resistance – Determination of tolerance
5. Determination of Coefficient of coupling between two mutually coupled coils
6. Determination of Capacitance using Schering Bridge
7. Determination of Inductance using Anderson bridge
8. Measurement of 3-phase reactive power with single-phase wattmeter
9. Measurement of parameters of a choke coil using 3-voltmeter and 3-ammeter methods
10. Determination of Inductance using Maxwell's bridge

11. Determination of Capacitance using DeSauty bridge
12. Calibration of LPF wattmeter – by Phantom loading
13. Wheatstone bridge – measurement of medium resistances
14. AC Potentiometer – Calibration of AC Voltmeter, Parameters of Choke coil

NOTE: Any ten experiments from the above list should be performed.

TEXTBOOKS:

1. "Electrical & Electronic Measurement & Instruments", A. K. Sawhney and Dhanpat Rai & Co. Publications, 2011, Reprint 2014.
2. "Electrical Measurements and measuring Instruments", E.W. Golding and F.C. Widdis, Reem Publications, 5th Edition, 2011

REFERENCE BOOKS:

1. "Electronic Instrumentation", H. S. Kalsi, Tata McGraw Hill, 3rd Edition, 2011.
2. "Electrical Measurements", Buckingham and Price, Prentice Hall, 1970.
3. "Electrical Measurements: Fundamentals, Concepts, Applications", M. U. Reissland, New Age International (P) Limited, 2010.

ONLINE LEARNING RESOURCES:

1. http://vlabs.iitkgp.ernet.in/asnm/#

Course Code	WEB DESIGNING		L	T	P	C
21A050708			1	0	2	2
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- To introduce students with no programming experience to the programming languages and techniques associated with the World Wide Web.
- To introduce web-based media-rich programming tools for creating interactive web pages.

COURSE OUTCOMES:

After completion of the course, the 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: Write simple client-side scripts using AJAX **(K5)**

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO2	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	-	-	-	-	-	-	-		

WEEK – 1:

HTML: What is a browser? What is HTML?, Elements and Tags, Basic HTML5 structure, Metadata , <title>, Adding favicon, Comments, headings.
Task: Create a Basic HTML document.

WEEK – 2:

HTML (continued): Block-Level Elements & Inline Elements, Links (Understand Absolute vs Relative paths), Lists, Images, iframe (embed youtube video).
Task: Create your Profile Page.

WEEK – 3:

HTML (continued): Tables: <table>, <tr>, <th>, <td>, Attributes for each Table element.
Task: Create a Class Timetable (to merge rows/columns, use rowspan/colspan).

WEEK – 4:

HTML (continued): Form Elements: <input>, <select>, <textarea>, <button>, Attributes for each Form element.

Task: Create a Student Hostel Application Form.

WEEK – 5:

Cascading Style Sheets (CSS): CSS Properties, Types of CSS, Selectors, box model, Pseudo elements, z-index.

Task: Make the Hostel Application Form designed in Module -4 beautiful using CSS (add colors, backgrounds, change font properties, borders, etc.)

WEEK – 6:

Bootstrap - CSS Framework: Layouts (Containers, Grid system), Forms, Other Components.

Task: Style the Hostel Application Form designed in Module-5still more beautiful using Bootstrap CSS (Re-size browser and check how the webpage displays in mobile resolution)

WEEK – 7:

HTTP & Browser Developer Tools: Understand HTTP Headers (Request & Response Headers), URL & its Anatomy, Developer Tools: Elements/Inspector, Console, Network, Sources, performance, Application Storage.

Task: Analyze various HTTP requests (initiators, timing diagrams, responses) and identify problems if any.

WEEK – 8:

JavaScript: Variables, Data Types, Operators, Statements, Objects, Functions, Events & Event Listeners, DOM.

Task: Design a simple calculator using JavaScript to perform sum, product, difference, and quotient operation.

WEEK – 9:

Dynamic HTML with JavaScript: Manipulate DOM, Error Handling, Promises, async/await, Modules.

Task: Design& develop a Shopping Cart Application with features including Add Products, Update Quantity, Display Price(Sub-Total & Total), Remove items/products from the cart.

WEEK – 10,11&12:

Design a Dynamic Web Application (at least 3 web pages) of our choice.

TEXTBOOKS:

1. "Programming the World Wide Web", Robet W Sebesta, Pearson, 7th Edition.
2. "Internet and World Wide Web How to Program", Paul J. Deitel, Harvey Deitel, Pearson, 6th Edition, 2020
3. "Web Technologies", Uttam K Roy, Oxford
4. "The Web Warrior Guide to Web Programming", Bai, Ekedahl, Farrelll, Gosselin, Zak, Karparhi, Maclntyre, Morrissey, Cengage.

REFERENCES:

1. "Ruby on Rails Up and Running, Lightning fast Web development", Bruce Tate, Curt Hibbs, Oreilly, 2006
2. "Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book", Dream Tech.
3. "An Introduction to Web Design, Programming", Paul S Wang, Sanda S Katila, Cengage.

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/

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	POWER SEMICONDUCTOR DRIVES		L	T	P	C
21A020420			3	0	0	3
Pre-requisite	Power Electronics, Electrical Machines-I, Electrical Machines-II	Semester	VI			

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 drives.**(K2)**

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.**(K2)**

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, Three 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-Problems.

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 (L3)

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 - PWM Control – Comparison of VSI and CSI Operations – Speed Torque Characteristics – Numerical Problems on Induction Motor Drives – Closed Loop Operation of Induction Motor Drives (Block Diagram Only) – Principles of Vector Control Static Rotor Resistance Control – Slip Power Recovery – V/f control of Induction Motor – Their Performance and Speed Torque Characteristics – Advantages- Applications – Problems.

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 Cyclo-converters. Load Commutated CSI Fed Synchronous Motor – Operation – Waveforms – Speed Torque

Characteristics – Applications – Advantages and Numerical Problems – Closed Loop Control Operation of Synchronous Motor Drives (Block Diagram Only).

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)

TEXT BOOKS:

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	POWER SYSTEM ANALYSIS		L	T	P	C
21A020421			3	0	0	3
Pre-requisite	Power System Architecture	Semester	VI			

COURSE OBJECTIVES:

- The use of per unit values and graph theory concepts, solving a problem using computer
- Formation of Y-bus and Z-bus of a Power System network, power flow studies by various methods.
- Different types of faults and power system analysis for symmetrical and also unsymmetrical faults.
- Analysis of power system for steady state and transient stability and also methods to improve stability.

COURSE OUTCOMES:

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

CO1: Understand the concepts of per unit values, Y-Bus and Z-bus formation, load flow studies, symmetrical and unsymmetrical fault calculations. **(K2)**

CO2: Apply the concepts of good algorithm for the given power system network and obtain the converged load flow solution and experiment some of these methods using modern **(K3)**

CO3: Analyze the symmetrical and unsymmetrical faults, stability of the system, perform fault calculations and improve the stability. **(K4)**

CO4: Develop accurate algorithms for different networks and determine load flow studies and zero, positive and negative sequence impedances to find fault calculations. **(K3)**

CO5: Design and select efficient Circuit Breakers to improve system stability. Implement them in resolving various day-to-day issues in a Power System. **(K5)**

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)

P. U. System and Y-bus Formation: Per-Unit representation of Power system elements - Per-Unit equivalent reactance network of a three phase Power System - Graph Theory: Definitions, Bus Incidence Matrix, Y-Bus formation by Direct and Singular Transformation Methods, Numerical Problems.

Learning Outcomes:- At the end of the unit, the student will be able to

- Understand the concepts of Per-Unit equivalent system(L2)

- Know about basic graph theory concepts as applied to power systems. (L4)
- Compute the Bus Incidence matrix (L3)
- Formulate Y-Bus matrix using different methods(L4).

UNIT – II (9 Hrs)

Formation of Z-bus : Formation of Z-Bus: Partial network, Algorithm for the Modification of Z-Bus Matrix for addition element for the following cases: Addition of element from a new bus to reference, Addition of element from a new bus to an old bus, Addition of element between an old bus to reference and Addition of element between two old busses - Modification of Z-Bus for the changes in network (Problems).

Learning Outcomes: At the end of the unit, the student will be able to

- Analyze the concept of formation of Z-Bus (L4)
- Develop algorithm for modification of Z-Bus. (L3)
- Determine the Z-Bus matrix(L3)
- Compute modified Z-Bus for the changes in network. (L3)

UNIT – III (9 Hrs)

Power Flow Analysis: static load flow equations – load flow solutions using gauss seidel method: algorithm and flowchart. Acceleration factor, load flow solution for simple power systems (max. 3-buses): newton raphson method in polar co-ordinates form: load flow solution-jacobian elements, algorithm and flowchart. Decoupled and fast decoupled methods.-comparison of different methods.

Learning Outcomes: At the end of the unit, the student will be able to

- Understand about Load flow Solution for Simple Power Systems. (L2)
- Determine the Load flow Solution using Gauss Seidel iterative method(L3)
- Determine the Load flow Solution using NR method in polar form (L3)
- Determine solution of DLF and FDLF (L3)
- Know about comparison of various Load flow solutions(L4)

UNIT – IV (9 Hrs)

Short Circuit Analysis: Symmetrical fault Analysis: Short Circuit Current and MVA Calculations, Fault levels, Application of Series Reactors. Symmetrical Component Theory, Positive, Negative and Zero sequence components: Positive, Negative and Zero sequence Networks. Unsymmetrical Fault Analysis: LG, LL, LLG and LLLG faults with and without fault impedance, Numerical Problems.

Learning Outcomes: At the end of the unit, the student will be able to

- Analyze the Calculations of MVA Calculations, Fault levels(L2)
- To understand about Sequence Components. (L2)
- Calculate the fault current using sequence impedances for unsymmetrical faults. (L2)

UNIT – V (9 Hrs)

Stability Analysis: Elementary concepts of Steady State, Dynamic and Transient Stabilities. Derivation of Swing Equation, Power Angle Curve and Determination of Steady State Stability. Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation. Numerical methods for solution of swing equation - Methods to improve Stability - Application of Auto Reclosing and Fast Operating Circuit Breakers

Learning Outcomes: At the end of the unit, the student will be able to

- Learn the stability and types of stability (L2)
- Analyze the stability using equal area criterion. (L3)
- To understand methods to improve stability (L2)
- Understand and evaluation of fault clearing angle and time. (L2)

TEXTBOOKS:

1. "Computer Methods in Power System Analysis", G. W. Stagg and A. H. El Abiad, Mc Graw Hill, 2006.
2. "Modern Power system Analysis", I. J. Nagrath & D. P. Kothari, Tata McGraw-Hill Publishing Company, 4th Edition, 2011.

REFERENCE BOOKS:

1. "Power System Analysis", Grainger and Stevenson, McGraw Hill, 1994.
2. "Power System Analysis", Hadi Saadat, McGraw Hill, 1998.
3. "Power System Analysis and Design", B. R. Gupta, S. Chand & Company, 2005.

Course Code	DIGITAL COMPUTING PLATFORMS		L	T	P	C
21A020422			3	0	0	3
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- Architecture and designing of 8086 Microprocessor with Assembling language programming and interfacing with various modules
- Understand the Interfacing of 8086 with various advanced communication devices
- Designing of 8051 Microcontroller with Assembling language programming and interfacing with various modules
- To know about Assembly Language Programs for the Digital Signal Processors and usage of Interrupts
- To understand Xilinx programming and understanding of Spartan FPGA board

COURSE OUTCOMES:

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

CO1: Understand the basic architecture & pin diagram of 8086 microprocessor **(K3)**

CO2: Apply the concepts to design Assembly language programming to perform a given task, Interrupt service routines for all interrupt types. **(K4)**

CO3: Design various applications to Microcontrollers and Microprocessors.**(K5)**

CO4: Write Assembly Language Programs for the Digital Signal Processors and use Interrupts for real-time control applications. **(K5)**

CO5: Write Xilinx programming and understanding of Spartan FPGA board.**(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)

Introduction to Microprocessors: Historical background- Evolution of microprocessors up to 64-bit. Architecture of 8086 microprocessor, special function of general purpose registers. 8086 flag registers and functions of 8086 flags – Addressing modes of 8086 – Instruction set of 8086 – Assembler directives - Pin diagram 8086 – Minimum mode and maximum mode of operation - Timing diagrams - CISC and ARM Processors.

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)

Assembly Language Programming & I/O Interface: Assembler directives – macros – simple programs involving logical – branch instructions – sorting – evaluating arithmetic expressions - string manipulations – 8255 PPI - various modes of operation - A/D - D/A converter interfacing, Memory interfacing to 8086 – interrupt structure of 8086 – vector interrupt table – interrupt service routine – interfacing interrupt controller 8259 - Need of DMA – serial communication standards – serial data transfer schemes.

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 – III (9 Hrs)

8051 Micro Controller Programming and Applications: Introduction to micro controllers, Functional block diagram, Instruction sets and addressing modes, interrupt structure – Timer – I/O ports – serial communication. Data transfer, manipulation, Control and I/O instructions – simple programming exercises key board and display interface – Closed loop control of servo motor – stepper motor control.

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 – IV (9 Hrs)

Introduction to TMS320LF2407 DSP Controller: Basic architectural features - Physical Memory - Software Tools. Introduction to Interrupts - Interrupt Hierarchy - Interrupt Control Registers. C2xx DSP CPU and Instruction Set: Introduction & code Generation - Components of the C2xx DSP core - Mapping External Devices to the C2xx core - peripheral interface - system configuration registers - Memory - Memory Addressing Modes - Assembly Programming Using the C2xx DSP Instruction set.

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-V (9 Hrs)

Field Programmable Gate Arrays (FPGA): Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA – Xilinx, XC3000 series - Configurable logic Blocks

(CLB) – Input / Output Block (IOB) – Programmable Interconnect Point (PIP) – Xilinx 4000 series – HDL programming –overview of Spartan 3E and Virtex II pro FPGA boards- case study.

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)

TEXTBOOKS:

1. "Microprocessor Architecture Programming and Applications with 8085", Ramesh S. Gaonkar, Penram Intl. Publishing, 6th Edition, 2013
2. "Advanced Microprocessor and Peripherals", A. K. Ray, K. M. Bhurchandi, Tata McGraw-Hill Publications, 3rd Edition, 2013.

REFERENCE BOOKS:

1. "Microprocessor and Interfacing by Douglas V Hall", Tata McGraw hill, 2nd Edition, 1992
2. "Microprocessor", Nilesh B Bahadure, PHI, 2010.
3. "The 8051 Micro Controller Architecture, Programming and Applications", Kenneth J Ayala, Pearson International publishing (India).
4. "DSP Based Electro Mechanical Motion Control", Hamid A. Tolyat, CRC press, 2004.
5. Application Notes from the webpage of Texas Instruments.
6. XC 3000 series datasheets (version 3.1). Xilinx Inc., USA, 1998
7. XC 4000 series datasheets (version 1.6). Xilinx Inc., USA, 1999
8. "FPGA based system design", Wayne Wolf, Prentice hall, 2004.

ONLINE LEARNING RESOURCES:

1. https://nptel.ac.in/courses/106108100
2. https://nptel.ac.in/courses/108105102
3. https://nptel.ac.in/courses/117108040

Course Code	POWER SYSTEMS OPERATION & CONTROL		L	T	P	C
21A020423			3	0	0	3
Pre-requisite	Power System Architecture	Semester	VI			

COURSE OBJECTIVES:

- To know about economic load dispatch problems with and without losses in Power Systems
- To distinguish between hydro-electric and thermal plants and coordination between them
- To understand about optimal power flow problems and solving using specified method
- To understand about Automatic Generation Control problems and solutions in Power Systems
- To understand necessity of reactive power control, compensation under no-load and load operation of transmission systems
- To understand about deregulation aspects in Power Systems

COURSE OUTCOMES:

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

CO1: Know about economic load dispatch problems with and without losses in Power Systems. **(K4)**

CO2: Distinguish between hydro-electric and thermal plants and coordination between them.**(K2)**

CO3: Understand about Automatic Generation Control problems.**(K2)**

CO4: Understand about optimal power flow problems.**(K2)**

CO5: Understand about deregulation aspects in Power Systems.**(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)

Economic Operation: Optimal Operation of Thermal Power Units, - Heat Rate Curve – Cost Curve –Incremental Fuel and Production Costs, Input-Output Characteristics, Optimum Generation Allocation with Line Losses Neglected. Optimum Generation Allocation Including the Effect of Transmission Line Losses – Loss Coefficients, General Transmission Line Loss Formula

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

- Understand economic load dispatch problem without losses of the Power System(L2)
- Understand economic load dispatch problem with losses of the Power System (L2)
- Know about computation of loss coefficients in Power Systems (L2)

UNIT – II (9 Hrs)

Optimal Scheduling of Hydrothermal System: Hydroelectric Power Plant Models, Scheduling Problems-Short Term Hydrothermal Scheduling Problem.

Optimal Power Flow: Optimal power flow problem formulation for loss and cost minimization, Solution of optimal power flow problem using Newton's method and Linear Programming technique.

Learning Outcomes: At the end of the unit, the student will be able to

- Distinguish between hydro electric and hydro thermal plants.(L2)
- Understand about characteristics of thermo-electric and hydro-thermal plants.(L2)
- Understand about optimal power flow problem formulation with losses and minimization of cost (L2)
- OPF problem solving using specified methods(L2)
- Find the numerical exercises in solving OPF problems(L3)

UNIT – III (9 Hrs)

Load Frequency Control: Speed governing mechanism, modeling of speed governing mechanism, models of various types of thermal plants (first order), Necessity of Keeping Frequency Constant. Definitions of Control Area – Single Area Control – Block Diagram Representation of an Isolated Power System – Steady State Analysis – Dynamic Response – Uncontrolled Case. Load Frequency Control of 2-Area System – Uncontrolled Case Tie-Line Bias Control. Proportional Plus Integral Control of Single Area and Its Block Diagram Representation, Steady State Response

Learning Outcomes: At the end of the unit, the student will be able to

- Understand about speed governing mechanism modeling(L2)
- Identify control areas and block diagram representations (L3)
- Identify Load Frequency Control problems with and without control(L3)
- Understand about steady state and dynamic responses of single and two area system with tie-lines (L2)
- Numerical problems of AGC problems(L2)

UNIT – IV (9 Hrs)

Reactive Power Control: Overview of Reactive Power Control – Reactive Power Compensation in Transmission Systems Advantages and Disadvantages of Different Types of Compensation Equipment for Transmission Systems; Load Compensation – Specifications of Load Compensator, Uncompensated and Compensated Transmission Lines: Shunt and Series Compensation

.

Learning Outcomes: At the end of the unit, the student will be able to

- Know about understanding of Reactive Power problems in Power Systems (L2)
- Distinguish between compensated and uncompensated lines under no-load and load.(L4)
- Distinguish between shunt and series compensation in Reactive Power Control.(L4)

UNIT – V (9 Hrs)

Introduction – Restructuring models utility functions, power exchanges, electricity market models, market power indices, Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting ,ancillary services, transmission pricing methods, demand-side management.

Learning Outcomes: At the end of the unit, the student will be able to

- Understand the philosophy of power exchange in electricity market.(L2)
- Know about transmission system pricing charges.(L2)
- Understand the trend of Demand side management (L2)

TEXTBOOKS:

1. "Power Generation, Operation and Control", Allen J. Wood and Bruce F. Wollenberg, John Wiley & Sons, Inc., New York, 2nd Edition, 1996.
2. "Power System Engineering", D P Kothari and I J Nagrath, McGraw Hill Education India Pvt. Limited, Chennai, 3rd Edition, 2019

REFERENCE BOOKS:

1. "Electric Energy Systems Theory: An Introduction", Olle I. Elgerd, TMH Publishing Company Ltd., New Delhi, 2nd Edition, 1983.
2. "Reactive Power Control in Electric Systems", T J E Miller, John Wiley & Sons, New York, 1982.

Course Code	MODERN CONTROL THEORY		L	T	P	C
21A020424			3	0	0	3
Pre-requisite	Control Systems Engineering	Semester	VI			

COURSE OBJECTIVE:

- Concepts of state vector, State transition matrix and solution of stat equations.
- Importance of controllability and observability concepts.
- Pole placement, state estimation using observers
- Lyapunov criterion for stability analysis
- Types of nonlinearities, their effect on system performance.

COURSE OUTCOMES:

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

CO1: Model a given dynamic system in state space, obtain the solution for the state equation **(K2)**

CO2: Test whether a given system is controllable and/or observable **(K3)**

CO3: Design a state feedback controller for pole placement **(K5)**

CO4: Design an observer for state estimation **(K5)**

CO5: Apply Lyapunov criterion and determine stability of a given system **(K3)**

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 (9 Hrs)

State Variable Description and Solution of State Equation: Concept of State – Derivation of State Space models for Linear Continuous time Systems from Schematic Models, Differential equations, Transfer functions and block diagrams – Non uniqueness of state model – State diagrams for continuous time state models – Solution of state equations – State transition matrix. Complete response of continuous time systems.

Learning Outcomes: At the end of the unit, the student will be able to

- Understand the concept of state space models(L2)
- Evaluate the solutions of the state equations.(L3)

UNIT – II (9 Hrs)

Controllability, Observability: Tests for controllability and observability for continuous time systems – Time varying case, minimum energy control, time invariant case, Principle of Duality,

Controllability and observability of state models in Jordan canonical form and other canonical forms. Effect of state feedback on controllability and observability.

Learning Outcomes: At the end of the unit, the student will be able to

- Understand the concepts of controllability and observability. (L2)
- Observe the effect of state feedback on controllability and observability.(L3)

UNIT – III (9 Hrs)

State Feedback Controllers and Observers: Design of State Feedback Controllers through Pole placement. Full-order observer and reduced-order observer. State estimation through Kalman Filters.

Learning Outcomes: At the end of the unit, the student will be able to

- Design of state feedback controller through pole placement.(L4)
- Estimate the state equation through Kalmans Filter.(L3)

UNIT – IV (9 Hrs)

Analysis of Nonlinear Systems: Introduction to nonlinear systems, Types of nonlinearities, Concept of describing functions, Derivation of describing functions for Dead zone, Saturation, backlash, relay with dead zone and Hysteresis - Jump Resonance. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Singular points, Phase plane analysis of nonlinear control systems.

Learning Outcomes: At the end of the unit, the student will be able to

- Analyze the non linear systems with the help of describing functions.(L4)
- Use methods for Isoclines for constructing trajectories.(L2)

UNIT – V (9 Hrs)

Stability Analysis: Stability in the sense of Lyapunov. Lyapunov‟s stability and Lyapunov”s instability theorems. Direct method of Lypanov for Linear and Nonlinear continuous time autonomous systems.

Learning Outcomes: At the end of the unit, the student will be able to

- Analyze the stability concepts.(L4)
- Analyze the direct method of Lypanov for Linear and Nonlinear systems.(L4)

TEXTBOOKS:

1. “Modern Control Engineering”, Katsuhiko Ogata, Prentice Hall, 5th Edition, 2010.
2. “Modern Control System Theory”, M. Gopal, New Age International Publishers, Revised 2nd Edition, 2005.

REFERENCE BOOKS:

1. "Control Systems Engineering", I.J. Nagarath and M.Gopal, New Age International Publishers, 5th Edition, 2007, Reprint 2012.
2. "Modern Control Engineering", D. Roy Choudhury, PHI Learning Private Limited, 9th Edition, January 2015.

Course Code	INTRODUCTION TO HYBRID AND ELECTRIC VEHICLES		L	T	P	C
21A020425			3	0	0	3
Pre-requisite	Electrical Machines-I, Electrical Machines-II	Semester	VI			

COURSE OBJECTIVES:

- Provide good foundation on hybrid and electrical vehicles
- To address the underlying concepts and methods behind power transmission in hybrid and electrical vehicles
- Familiarize energy storage systems for electrical and hybrid transportation.
- To design and develop basic schemes of electric vehicles and hybrid electric vehicles.

COURSE OUTCOMES:

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

CO1: Explain the working of hybrid and electric vehicles. **(K3)**

CO2: Choose a suitable drive scheme for developing a hybrid and electric vehicles depending on Resources.**(K3)**

CO3: Develop the electric propulsion unit and its control for application of electric vehicles.**(K3)**

CO4: Choose proper energy storage systems for vehicle applications. **(K3)**

CO5: Design and develop basic schemes of electric vehicles and hybrid electric vehicles.**(K5)**

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)

Electric Vehicle Propulsion and Energy Sources: Introduction to electric vehicles, vehicle mechanics - kinetics and dynamics, roadway fundamentals propulsion system design - force velocity characteristics, electric vehicle power source - battery capacity, state of charge and discharge, specific energy, specific power, Ragone plot. Battery modeling - run time battery model, first principle model, battery management system- soc measurement, battery cell balancing. Traction batteries - nickel metal hydride battery, Li-Ion, Lipolymer battery.

***Learning Outcomes*:** After successful completion of this unit, the students will be able to

- Summaries the concepts of electrical vehicle propulsion and energy sources. (L2)
- Identify the types of power sources for electrical vehicles.(L3)
- Demonstrate the design considerations for propulsion system. (L2)

UNIT – II (9 Hrs)

Electric Vehicle Power Plant and Drives: Introduction electric vehicle power plants. Induction machines, Permanent magnet machines, Switched reluctance machines. Power electronic converters-DC/DC converters - buck boost converter, isolated DC/DC converter. Two quadrant chopper and switching modes. AC drives- PWM, current control method. Switched reluctance machine drives - voltage control, current control.

***Learning Outcomes*:** After successful completion of this unit, the students will be able to

- Choose a suitable drive scheme for developing an electric vehicles depending on resources.(L1)
- List the various power electronic converters. (L1)
- Describe the working principle dc/dc converters and buck boost convertor. (L2)
- Explain about ac drives. (L2)

UNIT – III (9 Hrs)

Hybrid and Electric Drive Trains: Introduction hybrid electric vehicles, history and social importance, impact of modern drive trains in energy supplies. Hybrid traction and electric traction. Hybrid and electric drive train topologies. Power flow control and energy efficiency analysis, configuration and control of DC motor drives and Induction motor drives, Permanent magnet motor drives, Switched reluctance motor drives, drive system efficiency.

***Learning Outcomes*:** After successful completion of this unit, the students will be able to

- Identify the social importance of hybrid vehicles. (L3)
- Discus impact of modern drive trains in energy supplies. (L6)
- Compare hybrid and electric drive trains.(L2)
- Analyze the power flow control and energy efficiency. (L6)

UNIT – IV (9 Hrs)

Electric and Hybrid Vehicles-Case Studies: Parallel hybrid, series hybrid -charge sustaining, charge depleting. Hybrid vehicle case study – Toyota Prius, Honda Insight, Chevrolet Volt. 42 V system for traction applications. Lightly hybridized vehicles and low voltage systems. Electric vehicle case study - GM EV1, Nissan Leaf, Mitsubishi Miev. Hybrid electric heavy duty vehicles, fuel cell heavy duty vehicles

***Learning Outcomes*:** After successful completion of this unit, the students will be able to

- List the various electric and hybrid vehicles in the present market. (L1)
- Discus lightly hybridized vehicle and low voltage systems. (L6)
- Explain about hybrid electric heavy duty vehicles and fuel cell heavy duty vehicles. (L2)

UNIT – V (9 Hrs)

Electric and Hybrid Vehicle Design: Introduction to hybrid vehicle design. Matching the electric machine and the internal combustion engine. Sizing of propulsion motor, power

electronics, drive system. Selection of energy storage technology, communications, supporting subsystem. Energy management strategies in hybrid and electric vehicles classification.

***Learning Outcomes*:** After successful completion of this unit, the students will be able to

- Illustrate matching the electric machine and the internal combustion engine. (L2)
- Select the energy storage technology. (L3)
- Select the size of propulsion motor. (L3)
- Design and develop basic schemes of electric and hybrid electric vehicles. (L3)

TEXTBOOKS:

1. "Electric and Hybrid Vehicles: Design Fundamentals", Iqbal Hussein, CRC Press, 2nd Edition, 2003.
2. "Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach", Amir Khajepour, M. Saber Fallah, Avesta Goodarzi, Illustrated Edition, John Wiley & Sons, 2014.
3. "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, CRC Press, 2004.

REFERENCE BOOKS:

1. "Electric Vehicle Technology Explained", James Larminie, John Lowry, Wiley, 2003.
2. "Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles", John G. Hayes, G. Abas Goodarzi, 1st Edition, Wiley-Blackwell, 2018.

Course Code	POWER SYSTEMS LAB		L	T	P	C
21A020426			0	0	3	1.5
Pre-requisite	Power System Architecture	Semester	VI			

COURSE OBJECTIVES:

- To do the experiments (in machines lab) on various power system concepts like determination of sequence impedance, fault analysis, finding of sub transient reactance's.
- To draw the equivalent circuit of three winding transformer by conducting a suitable experiment.
- To develop the MATLAB program for formation of Y and Z buses. To develop the MATLAB programs for Gauss-Seidel and fast decoupled load flow studies.
- To develop the SIMULINK model for single area load frequency problem.

COURSE OUTCOMES:

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

CO1: Get the practical knowledge on calculation of sequence impedance, fault currents, voltages and sub transient reactance's. **(K4)**

CO2: Get the practical knowledge on how to draw the equivalent circuit of three winding transformer. **(K3)**

CO3: Get the knowledge on development of MATLAB program for formation of Y and Z buses. **(K3)**

CO4: Get the knowledge on development of MATLAB programs for Gauss-Seidel and Fast Decouple Load Flow studies. **(K3)**

CO5: Get the knowledge on development of SIMULINK model for single area load frequency problem. **(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

LIST OF EXPERIMENTS:

1. Determination of Sequence Impedances of Cylindrical Rotor Synchronous Machine
2. Determination of Sequence Impedances of salient pole Synchronous Machine
3. LG Fault Analysis on an un loaded alternator
4. LL Fault Analysis on conventional phases
5. LLG Fault Analysis

6. LLLG Fault Analysis
7. Determination of Sub transient reactance of salient pole synchronous machine
8. Equivalent circuit of three winding transformer.
9. Y Bus formation using Soft Tools
10. Z Bus formation using Soft Tools
11. Gauss-Seidel load flow analysis using Soft Tools
12. Newton-Raphson load flow analysis using Soft Tools
13. Fast decoupled load flow analysis using Soft Tools
14. Solve the Swing equation and Plot the swing curve
15. Develop a model for a uncontrolled single area load frequency control problem and simulate the same using Soft Tools.
16. Develop a model for PI controlled single area load frequency control problem and simulate the same using Soft Tools.
17. Develop a model for a uncontrolled two area load frequency control problem and simulate the same using Soft Tools.
18. Develop a model for PI controlled two area load frequency control problem and simulate the same using Soft Tools.

ONLINE LEARNING RESOURCES:

1. https://www.ee.iitb.ac.in/~vlabsync/template/vlab/index.html#

Course Code	DIGITAL COMPUTER PLATFORMS LAB		L	T	P	C
21A020427			0	0	3	1.5
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- Write Assembly language programming on 8086 Microprocessors.
- To Interface various devices with 8086.
- To develop MASAM Programming.
- For Interfacing of 8051 Microcontroller with its peripheral devices.

COURSE OUTCOMES:

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

CO1: Understand the basic concepts to write assembly language programming on 8086 Microprocessors.**(K2)**

CO2: Design various device configurations and Interfacing of various devices with 8086. **(K5)**

CO3: Understand the basic concepts to write programming on 8051 Microcontroller. **(K2)**

CO4: Design various Interfacing circuitry with 8051 Microcontroller with its peripheral devices.**(K5)**

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

LIST OF EXPERIMENTS:

1. Programs for 16 bit arithmetic operations for 8086 (using various addressing modes).
2. Program for sorting an array for 8086
3. Program for searching for a number or character in a string for 8086
4. Program for String manipulations for 8086
5. Interfacing ADC and DAC to 8086.
6. Parallel communication between two microprocessors using 8255.
7. Serial communication between two microprocessor kits using 8251.
8. Interfacing to 8086 and programming to control stepper motor.
9. Programming using arithmetic, logical and bit manipulation instructions of 8051
10. Program and verify Timer/Counter in 8051.

11. Program and verify interrupt handling in 8051.
12. UART operation in 8051.
13. Communication between 8051 kit and PC.
14. Interfacing LCD to 8051.
15. Interfacing matrix or keyboard to 8051.

REFERENCE BOOKS:

1. "Advanced Microprocessor and Peripherals", A. K. Ray, K. M. Bhurchandi, Tata McGraw-Hill Publications, 3rd Edition, 2013.
2. "Microprocessor and Interfacing", Douglas V Hall, 2nd Edition, Tata McGraw hill, 1992
3. "Microprocessors and Microcontrollers Lab Manual: 8086 & 8051", Srinivasa Murthy, Kindle Edition.

Course Code	POWER CONVERTERS USING MATLAB / SIMULINK LAB		L	T	P	C
21A020428			0	0	3	1.5
Pre-requisite	Power Electronics	Semester	VI			

COURSE OBJECTIVES:

- To understand the operation of Power Electronic converters
- To gain knowledge on the programming and simulation of Power Electronics.
- Understand the operation of Power Electronic Drives.
- Enable the students gain a fair knowledge on the simulation of Power Electronics Drives.

COURSE OUTCOMES:

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

CO1: Understand the operation of Power Electronic converters. **(K3)**

CO2: Gain a fair knowledge on the programming and simulation of Power Electronics converters.**(K3)**

CO3: Understand the operation of Power Electronic Drives. **(K3)**

CO4: Acquire skills of computer packages, MATLAB coding and SIMULINK in power electronics drives. **(K4)**

CO-PO MAPPING:

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

TOPICS TO BE COVERED:

MATLAB - Introduction, different tool boxes, creation of program files, creation of simulink files, GUI, commonly used blocks, Simpower system toolbox, control system toolbox, Sim Drive lines, Creation of functions, Project implementation through MATLAB

LIST OF EXPERIMENTS:

1. Simulation of Three Phase Fully Controlled Converter with R and R-L Loads using MATLAB/PSIM.
2. Simulation of Three Phase AC Voltage Controller with R and R-L Loads using MATLAB/PSIM.
3. Simulation of Three Phase Inverter in 180^0 Conduction Mode with Star & Delta Connected loads.
4. Simulation of Choppers.
5. Simulation of Single Phase Cycloconverter
6. Simulation of VSI fed Induction motor (square wave and PWM inverters).

7. Simulation of induction motor with open loop constant V/F control.
8. Simulation of Closed loop speed control of BLDC motor.
9. Simulation of speed control of separately excited DC motor.
10. Simulation of PMSM.
11. Implementation of buck and boost dc-dc converters
12. Study on the design of PI controllers and stability analysis for a DC-DC buck Converter
13. Simulation of 1-phase and 3-phase transformers

NOTE: Simulation software tools: Matlab/Simulink/PSPICE/PSIM)

ONLINE LEARNING RESOURCES:

1. http://vem-iitg.vlabs.ac.in/
2. https://vp-dei.vlabs.ac.in/Dreamweaver/

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	AMAZON WEB SERVICES		L	T	P	C
21A050704	(Common to CSE, EEE)		0	0	3	3
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- Apply Concept of AWS to implement cloud computing.
- To illustrate the basic AWS Concepts
- Demonstrate the use of AWS Concepts of cloud computing.
- To discuss the implementation of AWS services such as EC2, S3, Load Balancer etc
- To familiarize with cloud deployments.

COURSE OUTCOMES:

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

CO1: Analyze a cloud computing attributes and implementing different cloud storages. **(K4)**

CO2: Create a S3 bucket for universal data storage, Building a load balancer & VPC for traffic routing. **(K6)**

CO3: Deploying different types of web applications into cloud servers. **(K4)**

CO-PO MAPPING:

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

LIST OF MODULES:

Week 1:

Creation of AWS account and implementing EC2 services. Login into www.amazonconsole.com and creating a free tier account with individual mail id. Provide proper authentication with the help of credit card and creating instances.

Week 2:

Inspecting all the components of a AWS such as computing, routing, deploying , data storage and creating instances for every option. Monitoring the security aspects in the form of Security groups and creating security groups.

Week 3:

Analysing the different cloud storages such as S3 bucket, EBS. Creating a bucket in S3 and uploading different files in to the S3 bucket. Creating an EBS storage block and uploading bulk data.

Week 4:

The cloud computing is completely depends on networking and the traffic, the traffic must have proper balancing to avoid colloid. We are going to create a Load Balancer with proper traffic diversion rules (X canary) will be implemented for traffic switch.

Week 5:

Virtual Private cloud is one of the major important aspect for Cloud communication. VPC establish a communication between 2 or more private are public cloud. The VPC contains subnets. We can create VPC and subnets in AWS. Implementing the routing table to regularize the traffic.

Week 6:

Security is a major challenging in cloud computing. Security groups are used to create security rolls for the users. creating a security group and adopting different security rules for the cloud services.

Week 7 & 8:

Implement the following cloud computing applications.

1. Create an account with your individual mail id.
2. Connect the EC2 server with the browser by using SSH Key.
3. Implement LINUX commands in the AWS server.
4. Create a security group and download security key.
5. Implement different security roles for the users
6. Create an S3 bucket and upload the different files .txt, .php, .json etc.
7. Create a VPC and subnets to implement traffic switching.
8. Create a load balancer and route the traffic to balance the servers.

Week 9&10:

Ceate a project by using HTML / PHP /Json and upload the project into the server. Verify the accessing of website through IP address. The domain name should be selected and access the uploaded website with its domain naming address. (http://www.google.com) .

Course Code	ELECTRICAL DISTRIBUTION SYSTEMS		L	T	P	C
21A020429			3	0	0	3
Pre-requisite	Power Systems Architecture, Power System Analysis	Semester	VII			

COURSE OBJECTIVES:

- To explain classification of distribution systems
- To understand the aspects and design considerations in DC and AC distribution and their comparison
- To explain technical issues of substations such as location, ratings and bus bar arrangements
- To know the causes of low power factor and methods to improve power factor
- To understand 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. **(K4)**
CO2: Make voltage drop calculations in given distribution networks. **(K3)**
CO3: Learn principles of substation maintenance. **(K3)**
CO4: Compute power factor improvement for a given system and load. **(K4)**
CO5: Understand implementation of SCADA for distribution automation. **(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)

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)

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. Voltage Drop Calculations (Numerical Problems) In A.C. Distributors for The Following Cases: Power Factors Referred to Receiving End Voltage and With Respect to Respective Load Voltages.

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)
- Apply the voltage drop calculations of AC and DC distributors (L3)

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, Main and Transfer Bus Bar Double Breaker – One and Half Breaker System 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 (L3)

UNIT – IV (9 Hrs)

Power Factor Improvement: Voltage Drop and Power-Loss Calculations: Derivation for Voltage Drop and Power Loss in Lines, Manual Methods of Solution for Radial Networks, 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, Numerical Problems. Capacitive Compensation for Power-Factor Control - Effect of Shunt Capacitors (Fixed and Switched), Power Factor Correction- Economic Justification - Procedure to Determine the Best Capacitor Location.

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.
3. " Electrical Power Systems for Industrial Plants", Kamalesh Das, JAICO Publishing House, 2008.

Course Code	POWER SYSTEM PROTECTION		L	T	P	C
21A020430			3	0	0	3
Pre-requisite	Power System Analysis	Semester	VII			

COURSE OBJECTIVES:

- To understand different types of electromagnetic relays and microprocessor based relays.
- To explain the protection of Generators, Transformers, feeders and lines.
- To understand the technical aspects involved in the operation of circuit breakers.
- To provide protection from over voltages.

COURSE OUTCOMES:

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

CO1: Distinguish between the principles of operation of electromagnetic relays, static relays and microprocessor based relays. **(K3)**

CO2: Solve numerical problems for arc interruption and recovery in circuit breakers.**(K3)**

CO3: Determine the unprotected percentage of generator winding under fault occurrence and protection of transformers. **(K4)**

CO4: Identify various types of the relays in protecting feeders, lines and bus bars. **(K2)**

CO5: Demonstrate the protection of a power system from over voltages. **(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)

Relays: Electromagnetic Relays - Basic Requirements of Relays – Primary and Backup Protection - Construction Details of – Attracted Armature, Balanced Beam, Inductor Type and Differential Relays – Universal Torque Equation – Characteristics of Over Current, Direction and Distance Relays. Static Relays – Advantages and Disadvantages – Definite Time, Inverse and IDMT. Static Relays – Comparators – Amplitude and Phase Comparators. Microprocessor Based Relays – Advantages and Disadvantages – Block Diagram for Over Current (Definite, Inverse and IDMT) and Distance Relays.

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

- Understand the necessity of relays in power system, & characteristics of different relays. (L2)
- Analyze the construction details of static relays of IDMT and distance relays. (L4)

UNIT – II (9 Hrs)

Fuses: Definitions, characteristics, types, HRC fuses.

Circuit Breakers: Elementary Principles of Arc Interruption, Restriking Voltage and Recovery Voltage - Restriking Phenomenon, Average and Max. RRRV, Current Chopping and Resistance Switching - CB Ratings and Specifications, Types and Numerical Problems. – Auto Reclosures. Description and Operation of Following Types of Circuit Breakers: Minimum Oil Circuit Breakers, Air Blast Circuit Breakers, Vacuum and SF6 Circuit Breakers.

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

- Understand the concept of arc phenomenon in different types of circuit breakers. (L2)
- Understand the operation of circuit breakers and its characteristics of different types relays. (L2)
- Analyze the characteristics of ABCB and SF6 and Vacuum Circuit breakers. (L4)

UNIT – III (9 Hrs)

Protection of Generators & Transformers: Protection of Generators against Stator Faults, Rotor Faults and Abnormal Conditions. Restricted Earth Fault and Inter-Turn Fault Protection – calculation of percentage winding unprotected.

Protection of Transformers: Percentage Differential Protection, Numerical Problems on Design of CT Ratio, Buchholtz Relay Protection, Numerical Problems.

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

- Understand the protection of generators from Inter turn, rotor faults and stator faults.(L2)
- Understand the unprotected percentage of generator winding under fault occurrence.(L4)
- Analyze the operation of Buchholtz Relay Protection in transformers. (L4)

UNIT – IV (9 Hrs)

Protection of Feeders & Lines: Protection of Feeder (Radial & Ring Main) Using Over Current Relays. Protection of Transmission Line – 3 Zone Protection Using Distance Relays. Carrier Current Protection. Protection of Bus Bars.

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

- Understand the concept of radial and ring main feeders protection using relays.(L2)
- Analyze the concept three zone protection in transmission lines. (L4)

UNIT – V (9 Hrs)

Over Voltages in Power Systems: Generation of Over Voltages in Power Systems.-Protection against Lightning over Voltages - Valve Type and Zinc-Oxide Lighting Arresters - Insulation Coordination –BIL.

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

- Understand the concept of protection of power systems from over voltages(L2)

- Analyze the different types of Lighting arresters and the concept of basic insulation level in power systems. (L4)

TEXTBOOKS:

1. "Power System Protection and Switchgear", Badri Ram, D.N Viswakarma, TMH Publications, 2011.
2. "Switchgear and Protection", Sunil S Rao, Khanna Publishers, 1992.

REFERENCE BOOKS:

1. "Electrical Power Systems", C. L. Wadhwa, New Age international (P) Limited, Publishers, 2012.
2. "Transmission network Protection", Y.G. Paithankar , Taylor and Francis,2009.
3. "Power system protection and switch gear", Bhuvanesh Oza, TMH, 2010

Course Code	SWITCHED MODE POWER CONVERTERS		L	T	P	C
21A020431			3	0	0	3
Pre-requisite	Power Electronics	Semester	VII			

COURSE OBJECTIVES:

- Understand basic concepts of DC-DC converters.
- Understand the concepts of resonant converters and their classification, various types of multilevel inverters, power conditioners, UPS and filters.
- Apply various modulation and harmonic elimination techniques over the converters.

COURSE OUTCOMES:

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

CO1: Solve the problems and to design of various DC-DC converters. **(K3)**

CO2: Understand advanced converters of SMPCs. **(K2)**

CO3: Understand various types and performance characteristics of 1-ϕ and 3-ϕ inverters with single/multi levels. **(K2)**

CO4: Understand about power conditioners, UPS and filters . **(K2)**

CO5: Know about the applications of the above in Power Systems, EVE, and Renewable Energy Systems, etc.**(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)

DC-DC Converters: Principles of step down and step up converters – Analysis and state space modeling of Buck, Boost, Buck- Boost and Cuk converters – Numerical Examples.

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

- Understand and analyze various types of DC-DC converters (L2)
- Understand state space modeling of DC-DC converters (L2)
- Distinguish between stepdown and stepup converters (L2)
- Apply the above concepts to solve numerical problems (L4)

UNIT – II (9 Hrs)

Switching Mode Power Converters: Analysis and state space modelling of flyback, Forward, Luo, Half bridge and full bridge converters- control circuits and PWM techniques – Numerical examples.

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

- Understand various types of converters (L2)
- Know about state space modelling of converters (L2)
- Understand about various control circuits & PWM techniques (L2)
- Apply the above concepts to solve numerical problems (L4)

UNIT – III (9 Hrs)

Resonant Converters: Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS, Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control – Numerical Examples.

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

- Understand and analyze various types of resonant converters(L2)
- Classification of resonant converters(L2)
- know about output voltages and its waveforms for various configurations(L4)
- Distinguish between series and parallel resonant converters(L2)
- Apply the above concepts to solve numerical problems(L4)

UNIT – IV (9 Hrs)

DC-AC Converters: Single phase and three phase inverters, control using various (sine PWM, SVPWM and advanced modulation) techniques, various harmonic elimination techniques- Multilevel inverters- Concepts - Types: Diode clamped- Flying capacitor- Cascaded types- Applications.

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

- Understand and analyze different single phase and three phase inverters(L2)
- Understand various modulation techniques(L2)
- Understand various harmonic elimination techniques(L2)
- Understand various types of multilevel inverters with waveforms and their applications(L2)
- Apply the above concepts to solve numerical problems(L4)

UNIT – V (9 Hrs)

Power Conditioners, UPS & Filters: Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications – Selection of capacitors.

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

- Understand different types of power line disturbances, power conditioners, in detail working of UPS and its applications.(L2)

- Understand various types of filters with and without capacitors and selection of capacitors. (L2)
- Design inductor and transformer for various power electronic applications.(L2)

TEXTBOOKS:

1. "Power Electronics: Essentials and Applications", L. Umanand, Wiley, 2009
2. " Power Electronics handbook", M.H. Rashid, Elsevier Publication, 2001
3. "Course material on Switched Mode Power Conversion", V Ramanarayanan, Dept. of Electrical Engg. IISc. Bangalore.

REFERENCE BOOKS:

1. "Elements of Power Electronics", Philip T. Krein, Oxford University Press, 2012
2. "Power Electronics converters, Applications and design", Ned Mohan, Tore. M. Undeland, William. P. Robbins, John Wiley and Sons, 3rd Edition, 2006
3. "Power Electronics circuits, devices and applications", M.H. Rashid, Prentice Hall of India New Delhi, 3rd Edition, 2007.

Course Code	ELECTRICAL MACHINE DESIGN		L	T	P	C
21A020432			3	0	0	3
Pre-requisite	Electrical Machines – I, Electrical Machines – II	Semester	VII			

COURSE OBJECTIVES:

- Know about designing of DC machines along with windings.
- Understand about overall designing of 1-ϕ transformer.

COURSE OUTCOMES:

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

CO1: Understand various design factors, types of windings, choice of machine, selection and Ratings.**(K2)**

CO2: Design DC machine based on specified rating. **(K5)**

CO3: Design 1-ϕ transformer based on specified rating . **(K5)**

CO4: Design 3-ϕ Induction machine based on specified rating. **(K5)**

CO5: Design 3-ϕ Synchronous machine based on specified rating. **(K5)**

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)

Design Factors, Heating and Cooling: Introduction, Design factors, Limitations in Design. Theory of solid body heating, Heating time constant and estimation, Selection of machine power rating, types of duties and ratings (Description only), Selection of motor capacity for continuous, short-time and Intermittent periodic duty ratings, Concept of the methods used for determination of machine rating for variable loads.

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

- Understand the fundamental aspects of design parameters and limitations in designing.(L2)
- Understand the heating and cooling phenomenon in selection of machine rating and types of ratings(L2)
- Understand the design aspects of continuous and short time ratings of machines.(L2)
- Understand the design aspects of machine for variable loads (L2)

UNIT – II (9 Hrs)

Design of DC Machines: Output equation and main dimensions, choice of flux density, choice of ampere-conductors, Selection of number of poles, Length of air gap, Design of field winding, Simplex Lap and Wave windings-Numerical examples.

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

- Understand the designing aspects of DC machines with respect to performance equations and characteristics(L2).
- Understand the necessity of air gap and its length requirement between armature and field(L2)
- Understand the classification of field windings and design of them.(L2)
- Understand the about complete design aspects of DC machines(L2)
- Understand the design DC machine based on the specified ratings(L2)

UNIT – III (9 Hrs)

Design of Single Phase Transformers: Output of transformer, Design of core, Selection of type of winding, Design of insulation, Overall design, No-load current estimation, Design of tank with tubes-Numerical examples.

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

- Understand the design aspects of 1-ϕ transformer based on performance equations.(L2)
- Understand the about the design aspects based on core, type of winding.(L2)
- Understand the design of tanks in 1-ϕ transformers.(L2)
- Understand the design aspects of insulations in transformers.(L2)
- Understand the complete design aspects of 1-ϕ transformers and to be able to design for specified rating.(L2)

UNIT – IV (9 Hrs)

Design of Induction Machines: Three phase Induction machine output equation and main dimensions, Selection of stator and rotor slots, Length of air gap, and Reduction of harmonic torques, Hemitropic, whole coil and Mush windings-Numerical examples.

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

- Analyze the design aspects of three phase induction machines based on performance equations.(L4)
- Understand the selection of stator and rotor slots, air gap , necessity mitigating harmonic torque.(L2)
- Analyze the various winding designs of induction machines and to distinguish between squirrel cage & slip ring machines.(L4)
- Understand the complete aspects of 3-ϕ induction machine and to be able to design for a specified rating.(L2)

UNIT – V (9 Hrs)

Design of Synchronous Machines: Output equation, Main dimensions for cylindrical and salient pole machines, Choice of specific magnetic and electric loadings, Effect of SCR on machine performance, Length of air gap, Selection of stator slots, and mitigation of harmonics-Numerical examples.

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

- Understand the design aspects of synchronous machines based on performance equations. (L2)
- Analyze the distinguish between cylindrical and salient pole machines. (L4)
- Understand the synchronous machine based on shunt circuit ratio calculations. (L2)
- Analyze the specific electric and magnetic loads and their choice. (L4)
- Understand the complete design aspects of 3-ϕ synchronous machine and to be able to design for a specified rating. (L2)

TEXTBOOKS:

1. "A course on Electrical Machine Design", A.K. Sawhney and Chakrabarti, Dhanpat Rai & Co Pvt. Ltd., 6th Edition, 2014.
2. "Design of Electrical Machines", K. G. Upadhyay, New Age International Pvt. Ltd., 1st Edition, 2018.

REFERENCE BOOKS:

1. "The performance and Design of Alternating Current Machines", M G Say, CBS Publishers & Distributors, New Delhi, 3rd Edition, 2002.
2. "Performance and Design of Direct Current Machines", A. E. Clayton and N N Hancock, CBS Publication, 3rd Edition, 2004.
3. "Design of Electrical Machines", V. N. Mittle and Aravind Mittal, Standard Publishers Distributions, 2009.
4. "Principles of Electrical Machine Design", R. K. Agarwal, S.K. Kataria & Sons, 2010

Course Code	UTILIZATION OF ELECTRICAL ENERGY		L	T	P	C
21A020433			3	0	0	3
Pre-requisite	Power System Architecture	Semester	VII			

COURSE OBJECTIVES:

- The laws of illumination and their application for various lighting schemes
- Principles and methods for electric heating and welding.
- Systems of electric traction, study of traction equipment, mechanics of train movement and associated calculations

COURSE OUTCOMES:

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

CO1: Develop a lighting scheme for a given practical case. **(K3)**

CO2: Analyze the performance of Heating and Welding methods. **(K4)**

CO3: Make all numerical calculations associated with electric traction. **(K3)**

CO4: Analyze the characteristics of Electric traction and its calculations **(K4)**

CO5: Assess the economic aspects in utilization of electrical energy. **(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	-	-	-	-	-	1	3	2

UNIT – I (9 Hrs)

Illumination: Definition –Laws of Illumination–Polar Curves – Calculation of MHCP and MSCP. Lamps: Incandescent Lamp, Sodium Vapour Lamp, Fluorescent Lamp, CFL and LED. Requirement of Good Lighting Scheme – Types, Design and Calculation of Illumination. Street Lighting and Factory Lighting – Numerical Problems – Energy Conservation methods.

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

- Understand the Illumination concepts and its Laws.(L2)
- Understand the different energy conservation methods(L2)
- To know the different Types of Lamps.(L3)
- Evaluate the illumination levels.(L4)

UNIT – II (9 Hrs)

Electric Heating & Welding: Electrical Heating: Advantages. Methods of Electric Heating – Resistance, Arc, Induction and Dielectric Heating – Energy conservation methods. Electric

Welding: Types – Resistance, Electric Arc, Gas Welding. Ultrasonic, Welding Electrodes of Various Metals, Defects in Welding. Electrolysis - Faraday's Laws, Applications of Electrolysis, Power Supply for Electrolysis.

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

- Analyze the heating concepts and its energy conservation methods. (L4)
- Analyze the welding methods and its energy conservation methods. (L4)
- Understand the concept of Faraday's laws and need for electrolysis in Illumination. (L2)

UNIT – III (9 Hrs)

Electric Traction–I: Introduction – Systems of Electric Traction. Comparison Between AC and DC Traction – Special Features of Traction Motors - The Locomotive – Wheel arrangement and Riding Qualities – Transmission of Drive – Characteristics and Control of Locomotives and Motor Coaches for Track Electrification – DC Equipment – AC Equipment – Electric Braking with DC Motors and with AC Motors – Control Gear –Auxiliary Equipment – Track Equipment and Collector Gear – Conductor-Rail Equipment – Overhead Equipment – Calculation of Sags and Tensions – Collector Gear for Overhead Equipment.

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

- Understand the electric traction and its classifications.(L2)
- Evaluate the sags and tension of the traction systems.(L4)
- Understand the braking methods in AC and DC traction systems.(L2)

UNIT – IV (9 Hrs)

Electric Traction–II: Mechanics of Train Movement. Speed-Time Curves of Different Services – Trapezoidal and Quadrilateral Speed-Time Curves – Numerical Problems. Calculations of Tractive Effort, Power, Specific Energy Consumption - Effect of Varying Acceleration and Braking Retardation, Adhesive Weight and Coefficient of Adhesion – Problems.

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

- Understand the characteristics of Traction systems and its calculations. (L2)
- Evaluate the effects of accelerating and braking concepts in traction motors.(L4)
- Evaluate the adhesive and coefficient adhesion in different tractions.(L4)

UNIT – V (9 Hrs)

Economic Aspects of Utilizing Electrical energy: Power Factor Improvement, Load Factor improvement, Off Peak Loads- Use of Exhaust Steam, Waste Heat recovery, Pit Head Generation, Diesel Plant, General Comparison of Private Plant and Public Supply- Initial Cost and Efficiency, Capitalization of Losses, Choice of Voltage.

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

- Understand the economic aspects in utilization. (L2)

- Understand the concepts of power factor and load factor improvement methods in utilization.(L2)

TEXTBOOKS:

1. "Utilization of Electric Energy", E. Openshaw Taylor and V. V. L. Rao, Universities Press, 2009.
2. "Art & Science of Utilization of electrical Energy", Partab, Dhanpat Rai & Co., 2004.

REFERENCE BOOKS:

1. "Generation, distribution and utilization of electrical energy", C.L Wadhwa, Wiley Eastern Limited,1993
2. "Electrical Power", S. L. Uppal, Khanna pulishers,1988.

Course Code	POWER QUALITY		L	T	P	C
21A020434			3	0	0	3
Pre-requisite	Power System Architecture, Power System Analysis	Semester	VII			

COURSE OBJECTIVES:

- To know about introduction on power quality issues.
- To learn about voltage disturbances and power transients that is occurring in power Systems.
- To know the concept of harmonics in the system and their effect on different power system equipment.

COURSE OUTCOMES:

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

CO1: Knowledge about introduction on power quality issues.**(K3)**

CO2: Analyze voltage disturbances and power transients that are occurring in power systems.**(K4)**

CO3: Understand the concept of harmonics in the system and their effect on different power system equipment. **(K2)**

CO4: Knowledge about different power quality measuring and monitoring concepts.**(K4)**

CO5: Knowledge about power quality enhancement using custom power devices. **(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)

Introduction: Definition of Power Quality- Power Quality Terminology – Classification of Power Quality Issues-Magnitude versus Duration Plot - Power Quality Standards - Responsibilities of Suppliers and Users of Electric Power-CBEMA and ITI Curves.

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

- Learn about various issues of power quality (L2)
- Know about the evaluation procedure of power quality issues(L2)
- Distinguish between short duration and long duration over voltages(L3)
- Know about voltage fluctuations and power frequency variations (L2)

- Learn about CBEMA and ITI curves in power quality issues (L2)

UNIT – II (9 Hrs)

Transients, Short Duration and Long Duration Variations: Categories and Characteristics of Electromagnetic Phenomena in Power Systems- Impulsive and Oscillatory Transients- Interruption - Sag-Swell-Sustained Interruption - Under Voltage – Over Voltage–Outage. Sources of Different Power Quality Disturbances- Principles of Regulating the Voltage- Conventional Devices for Voltage Regulation.

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

- Understand what is meant by voltage sag(L2)
- Know about voltage sag performance estimations(L2)
- Know about fundamental principles of protection from sag and to study various protection schemes (L2)
- Understand about various devices for over voltage protection(L2)
- Know about utility system lightning protections.(L2)

UNIT – III (9 Hrs)

Fundamentals of Harmonics & Applied Harmonics: Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quality Under Non Sinusoidal Conditions, Harmonic Indices, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads. Applied Harmonics**:** Effects Of Harmonics, Harmonic Distortion Evaluations, Principles of Controlling Harmonics, Devices for Controlling Harmonic Distortion.

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

- Understand about effects of harmonics(L2)
- Distinguish between voltage and current harmonics(L3)
- Understand about computation of harmonic indices (L2)
- Understand about the filters used for controlling harmonic distortion (L2)

UNIT – IV (9 Hrs)

Power Quality Monitoring: Power Quality Benchmarking-Monitoring Considerations- Choosing Monitoring Locations- Permanent Power Quality Monitoring Equipment-Historical Perspective of Power Quality Measuring Instruments- Power Quality Measurement Equipment- Types of Instruments- Assessment of Power Quality Measurement Data- Power Quality Monitoring Standards.

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

- Know about what is meant by bench marking in power quality issues. (L2)
- Identify and able to compute voltage variation indices. (L3)
- Identify and able to compute harmonic indices. (L3)

UNIT – V (9 Hrs)

Power Quality Enhancement using Custom Power Devices: Introduction to Custom Power Devices-Network Reconfiguring Type: Solid State Current Limiter (SSCL)-Solid State Breaker (SSB) -Solid State Transfer Switch (SSTS) - Compensating Type: Dynamic Voltage Restorer (DVR)-Unified Power Quality Conditioner(UPQC)-Principle of Operation Only.

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

- Know about power quality enhancement considerations.(L2)
- Know about power quality custom power devices.(L2)

TEXTBOOKS:

1. "Electrical Power Systems Quality", Roger C. Dugan, Mark F. Mc Granaghan, Surya Santoso, H. Wayne Beaty, Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition, 2012.
2. "Power quality", C. Sankaran, CRC Press.

REFERENCE BOOKS:

1. "Understanding Power quality problems – Voltage Sags and Interruptions", Math H. J. Bollen IEEE Press Series on Power Engineering, WILEY, 2007.
2. "Power quality – VAR Compensation in Power Systems", R. Sastry Vedam, Mulukutla S. Sarma, CRC Press, 2009, First Indian Reprint 2013.
3. "Fundamentals of Electric Power Quality", Surya Santoso, Create Space, 2012.

Course Code	CONCEPTS OF DIGITAL SIGNAL PROCESSING		L	T	P	C
21A020435			3	0	0	3
Pre-requisite	NIL	Semester	V			

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: Formulate difference equations for the given discrete time systems. **(K2)**
CO2: Apply FFT algorithms for determining the DFT of a given signal. **(K3)**
CO3: Design IIR digital filter from the given specification. **(K3)**
CO4: Design FIR digital filter from the given specifications. **(K3)**
CO5: Outline the concept of multi rate DSP and applications of DSP. **(K2)**

CO-PO MAPPING:

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

UNIT – I (9 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)
- Analyze the linear time-invariant systems by Z transform. (L3)

UNIT – II (9 Hrs)

Discrete Flourier 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-Frequencyalgorithms, 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.(L1)
- Find N-Point DFT/FFT for a given signal /sequence.(L2)

UNIT – III (9 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, 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

- Understands signal flow graph and block diagram representations of difference
- Equations that realize digital filters.(L1)
- Realization of different structures for IIR filters.(L2)
- Design of IIR filters using different techniques.(L4)

UNIT – IV (9 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(L1)
- Realization of different structures for FIR filters(L2)
- FIR filter design based on windowing methods.(L4)
- Compare FIR and IIR filters(L5)

UNIT – V (9 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. (L1)
- Analyze the effect of coefficient quantization. (L4)
- Understand the concept of multi rate Digital Signal Processing. (L1)
- Analyze the input and output spectrum of Decimation and Interpolation. (L4)

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, New Delhi, 2nd Edition, 2004.
2. "Digital Signal Processing, Schaum's Outline series", MH Hayes, 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.

Course Code	MODERN POWER ELECTRONICS		L	T	P	C
21A020436			3	0	0	3
Pre-requisite	Power Electronics	Semester	VII			

COURSE OBJECTIVES:

- Understand Principle of Operation Advanced Power Converters.
- Describe the operation of multi level inverters with switching strategies for high power applications.
- Comprehend the design of resonant converters and switched mode power supplies.

COURSE OUTCOMES:

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

CO1: Understand Principle of Operation Advanced Power Converters. **(K2)**

CO2: Develop and analyze various converter topologies. **(K5)**

CO3: Describe the operation of multi level inverters with switching strategies for high power applications. **(K3)**

CO4: Comprehend the design of resonant converters and switched mode power supplies. **(K3)**

CO5: Analyze the concept of bi-directional AC power supply **(K4)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

PWM Inverters: Principle of Operation – Performance Parameters – Single Phase Bridge Inverter – Output Voltage and Current With R, R-L & R-L-C Loads – Voltage Control of Single Phase Inverters – Advanced Modulation Techniques for Improved Performance –Numerical Problems.

Three Phase Inverters –180 Degree Condition –120 Degree Conduction – Analysis – Output Voltage and Current With R, R-L & R-L-C Loads – Voltage Control of Three Phase Inverters – Comparison of PWM Techniques – Harmonic Reductions – Current Source Inverter – Variable DC Link Inverter – Buck and Boost Inverter – Inverter Circuit Design – Applications – Numerical Problems.

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

- Understand the operation of CSI and VSI.(L2)
- Understand the operation of Buck-Boost Inverters.(L2)

UNIT – II (9 Hrs)

Resonant Pulse Inverters: Series Resonant Inverters – Analysis with Unidirectional Switches & Bidirectional Switches – Evaluation of Currents and Voltages – Frequency Response of Series Resonant Inverters – Series Loaded Inverter –Parallel Loaded Inverter –Series and Parallel Loaded Inverters – Parallel Resonant Inverters – Voltage Control of Resonant Inverters – Class E Resonant Inverter & Class E Resonant Rectifier – Numerical Problems.

Resonant Converters – Zero Current Switching Resonant Converters – L Type– M Type – Zero Voltage Switching Resonant Converters – Comparison Between ZCS And ZVS – Resonant Converters – Two Quadrant ZVS Resonant Converters – Resonant DC-Link Inverters – Numerical Problems.

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

- Understand the concept of frequency response of series resonant inverters.(L2)
- Compare the ZCS and ZVS Resonant Converters.(L3)

UNIT – III (9 Hrs)

Multilevel Inverters: Multilevel Concept – Types of Multilevel Inverters – Diode Clamped Multilevel Inverter – Improved Diode Clamped Inverter – Flying Capacitors Multilevel Inverter – Cascaded Multilevel Inverter– Principle Of Operation – Main Features– Applications – Reactive Power Compensation, Back to Back Intertie System, Adjustable Drives– Switching Device Currents – DC Link Capacitor Voltage Balancing – Features of Multilevel Inverters – Comparisons of Multilevel Converters – Numerical Problems.

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

- Understand the concept of Multi Level Inverters.(L2)
- Compare the operation of Multilevel Converters.(L3)

UNIT – IV (9 Hrs)

DC Power Supplies : DC Power Supplies – Types – Switched Mode DC Power Supplies – Fly Back Converter –Forward Converter – Push-Pull Converter – Half Bridge Converter – Full Bridge Converter –Resonant DC Power Supplies – Bidirectional Power Supplies – Applications – Numerical Problems.

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

- Understand the concept of Fly back Converters.(L2)
- Analyze the applications of Resonant DC Power Supplies.(L4)

UNIT – V (9 Hrs)

AC Power Supplies: AC Power Supplies – Types – Switched Mode Ac Power Supplies – Resonant AC Power Supplies – Bidirectional Ac Power Supplies – Multistage Conversions – Control Circuits – Power Line Disturbances – Power Conditioners – Uninterruptible Power Supplies – Applications – Numerical Problems.

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

- Understand the concept of Bi Directional AC Power Supplies.(L2)
- Analyze the operation of UPS and its applications.(L4)

TEXTBOOKS:

1. "Power Electronics", Mohammed H. Rashid, Pearson Education, 3rd Edition.
2. "Fundamentals of Power Electronics", Robert Warren Erickson and Dragan Maksimovic, Springer US, 2nd Edition, 2001.

Course Code	HVDC & FACTS		L	T	P	C
21A020437			3	0	0	3
Pre-requisite	Power Electronics	Semester	VII			

COURSE OBJECTIVES:

- High voltage DC transmission systems
- Flexible AC transmission systems
- Various configurations of the above, Principle of operation, Characteristics of various FACTS devices

COURSE OUTCOMES:

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

CO1: Understand the various HVDC concepts. **(K3)**
CO2: Analyze the HVDC Links and its configurations. **(K4)**
CO3: Analyze the DC Link power flow control. **(K4)**
CO4: Describe the basic operating principles of various flexible AC systems **(K3)**
CO5: Apply various FACT controllers in the power system **(K5)**

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	1	-	-	-	-	-	3	2

UNIT – I (9 Hrs)

Introduction: Electrical Transmission Networks, Conventional Control Mechanisms-Automatic Generation Control, Excitation Control, Transformer Tap-Changer Control, Phase-Shifting Transformers; Advances in Power-Electronic Switching Devices, Principles and Applications of Semiconductor Switches; Limitations of Conventional Transmission Systems, Emerging Transmission Networks, HVDC and FACTS.

Learning Outcomes: At the end of the module, the learners will be able to

- Know about difference between HVDC and FACTS (L2)
- Know about limitations of conventional transmission systems(L2)
- Know about recent developments in Power Electronic switching devices(L2)

UNIT – II (9 Hrs)

High Voltage DC Transmission–I: Types of HVDC links - Monopolar, Homopolar, Bipolar and Back-to-Back, Advantages and disadvantages of HVDC Transmission, Analysis of Greatz

circuit, Analysis of bridge circuit without overlap, Analysis of bridge with overlap less than 600, Rectifier and inverter characteristics, complete characteristics of rectifier and inverter, Equivalent circuit of HVDC Link.

Learning Outcomes: At the end of the module, the learners will be able to

- To learn about various HVDC link configurations(L3)
- To develop equivalent circuit of HVDC link(L3)

UNIT – III (9 Hrs)

High Voltage DC Transmission–II: Desired features and means of control, control of the direct current transmission link, Constant current control, Constant ignition angle control, Constant extinction angle control, Converter firing-angle control-IPC and EPC, frequency control and Tap changer control, Starting, Stopping and Reversal of power flow in HVDC links.

Learning Outcomes :At the end of the module, the learners will be able to

- To learn about various DC link control techniques . (L3)
- To learn about starting, stopping and reversal of power flow in DC links. (L3)

UNIT – IV (9 Hrs)

Flexible AC Transmission Systems-I: Types of FACTS Controllers, brief description about various types of FACTS controllers, Operation of 6-pulse converter, Transformer Connections for 12-pulse, 24-pulse and 48-pulse operation, principle of operation of various types of Controllable shunt Var Generation, Principle of switching converter type shunt compensator, principles of operation of various types of Controllable Series VAR Generation, Principle of Switching Converter type series compensator.

Learning Outcomes: At the end of the module, the learners will be able to

- To understand principle of working and differences between various pulse configurations of various converters. (L2)
- To understand the necessity of compensators. (L2)
- To analyze the configurations of shunt, VAR, series configurations, etc.(L3)

UNIT – V (9 Hrs)

Flexible AC Transmission Systems-II: Unified Power Flow Controller (UPFC) – Principle of operation, Transmission Control Capabilities, Independent Real and Reactive Power Flow Control; Interline Power Flow Controller (IPFC) – Principle of operation and Characteristics, UPFC and IPFC control structures (only block diagram description), objectives and approaches of voltage and phase angle regulators.

Learning Outcomes: At the end of the module, the learners will be able to

- To know more about advanced Power flow controllers. (L2)
- To analyze the transmission control strategies. (L2)
- To know about voltage and phase regulators. (L2)

TEXTBOOKS:

1. "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", Narain G. Hingorani and Laszlo Gyugyi, IEEE Press, Wiley-Interscience, New Jersey, 2000.
2. "Direct current transmission, Vol. I", E.W. Kimbark, Wiley Inter science, New York, 1971.

REFERENCE BOOKS:

1. "FACTS Controllers in Power Transmission and Distribution", K R Padiyar, New Age International Publishers, New Delhi, 2007.
2. "FACTS: Modelling and Simulation in Power Networks", Anrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Pérez and César Angeles-Camacho, John Wiley & Sons, West Sussex, 2004.

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. And students can be able to 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)

UNIT – V (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)

TEXTBOOKS:

1. "Management Science", A.R Aryasri, TMH, 2013
2. "Management", Stoner, Freeman, Gilbert, Pearson Education, New Delhi, 2012.

REFERENCE BOOKS:

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	IOT APPLICATIONS IN ELECTRICAL ENGINEERING		L	T	P	C
21A020702			1	0	2	2
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- Understand basics of Internet of Things and Micro Electro Mechanical Systems (MEMS)
- fundamentals in design and fabrication process
- Analyze motion less and motion detectors in IoT applications
- Understand about Analyze applications of IoT in smart grid
- Apply the concept of Internet of Energy for various applications

COURSE OUTCOMES:

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

CO1: Understand the concept of IoT in Electrical Engineering.**(K2)**

CO2: Analyze various types of motionless sensors and various types of motion detectors. **(K4)**

CO3: Apply various applications of IoT in smart grid.**(K3)**

CO4: Design future working environment with Energy internet.**(K5)**

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	-	-	-	-	-	1	-	-
CO4	3	3	3	2	-	2	-	-	-	-	-	-	-	-

Module – I: IOT Introduction

What is an IoT - Architecture of IoT - What is Arduino / Node MCU / Raspberry, pin Configurations, Introduction to Arduino IDE

Practice:

1. Introduction to Arduino/Esp32, Introduction to raspberry Pi.

Module – II: IOT Sensors

Light sensor, Ultrasonic sensor, Temperature sensor, Knock Sensor, Object Detection Sensor, Metal Touch Sensor, Water Level Sensor, Vibration Sensor, Air Pressure sensor, Motors, Types of Motors, Ultrasonic Sensor, Soil moisture sensor ,LCD’s

Practice:

1. Measurement of temperature & pressure values of the process using raspberry pi/node mcu/esp32.
2. Modules and Sensors Interfacing (IR sensor, Ultrasonic sensors, Soil moisture sensor) using Raspberry pi/node mcu /esp32.
3. Modules and Actuators Interfacing (Relay, Motor, Buzzer) using Raspberry pi/node mcu/ /esp32.

Module – III: IoT Communication Technologies

Introduction to Open Systems Interconnection (OSI) model – Gateway – Cloud – Connectivity - Data processing - User interface – Bluetooth – RFID - Wireless Technologies.

Practice:

1. Demonstration of Bluetooth communication protocol

Module – IV: IoT Configuration

Elements of IoT: Hardware components – computing (Arduino/Raspberry Pi), communication, Sensing, Actuation, I/O interfaces Software Components. Programming API's.

Practice:

1. Assemble IoT hardware components with proper programming.

Module – V: Visualization and data types of IoT

Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT

Practice:

1. Visualization of diverse sensor data using dashboard (part of IoT's 'control panel')

Module – VI: Retrieving Data

Extraction from Web: Grabbing the content from a web page, sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

Practice:

1. Device control using mobile Apps or through Web pages.

Projects:

1. Home automation through IoT
2. Smart Electric Grid
3. Smart Agriculture system
4. Automation using controller via Bluetooth
5. Temperature controlled Fan/cooler using controller
6. Automatic streetlight
7. Smart Parking system
8. Automatic Energy Meter through IoT

TEXTBOOKS:

1. "Sensor Technology Hand book", Jon S. Wilson, Newnes Publisher, 2004
2. "MEMS and Microsystems: Design and manufacture", Tai Ran Hsu, Mc Graw Hill Education, 1st Edition, 2017
3. "From Smart grid to Internet of Energy", Ersan Kabalci and Yasin Kabalci, Academic Press, 1st Edition, 2019

REFERENCE BOOKS:

1. "Internet of Things: Principles and Paradigms", Raj Kumar Buyya and Amir Vahid Dastjerdi, Morgan Kaufmann Publisher, Kindle Edition, 2016
2. "Energy Harvesting Systems for IoT Applications: Generation, Storage and Power Management", Yen Kheng Tan and Mark Wong, 1st Edition, CRC Press, 2019
3. "Internet of Things", RMD Sundaram Shriram, K. Vasudevan and Abhishek S. Nagarajan, Wiley, 2019

ONLINE LEARNING RESOURCES:

1. https://www.tutorialspoint.com/internet_of_things/index.htm
2. https://en.wikipedia.org/wiki/Industrial_internet_of_things
3. https://www.javatpoint.com/iot-internet-of-things
4. https://www.guru99.com/iot-tutorial.html

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	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)

UNIT – III (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)

UNIT – IV (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)

UNIT – V (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)

TEXTBOOKS:

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.

REFERENCE BOOKS:

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)

UNIT – III (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)

UNIT – IV (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)

UNIT – V (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	INTEGRATED CIRCUITS AND APPLICATIONS		L	T	P	C
21A040501			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- To introduce the basic building blocks of linear integrated circuits.
- To impart knowledge on linear and non-linear applications of Op-Amps.
- To design various circuits using Op-Amps.
- To familiarize with specialized ICs such as 555 timer and voltage regulators.
- To familiarize with digital ICs.

COURSE OUTCOMES:

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

CO1: Explain the construction and characteristics of Operational Amplifier IC **(K2)**

CO2: Explain various linear & non-linear applications of Op-amp **(K2)**

CO3: Develop knowledge on filters and describe internal circuit operation of 555 timer and voltage regulators ICs **(K3)**

CO4: Summarize combinational circuits using Digital integrated circuits **(K3)**

CO5: Explain the internal structure of sequential Digital integrated circuits **(K3)**

CO-PO MAPPING:

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

UNIT – I (8 Hrs)

INTEGRATED CIRCUITS AND OPERATIONAL AMPLIFIER: Introduction, Classification of IC's, IC chip size and circuit complexity, basic information of Op-Amp IC741 Op-Amp and its features, the ideal Operational amplifier, Op-Amp internal circuit, Op-Amp characteristics - DC and AC.

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

- Understand the concept of IC & classifications (L2)
- Understand the concepts of Operational amplifier. (L2)
- Illustrate the internal circuit of operational amplifier (L2)
- Analyze DC & AC characteristics of op-amp (L4)

UNIT – II (10 Hrs)

LINEAR APPLICATIONS OF OP-AMP: Inverting and non-inverting amplifiers, adder, subtractor, Instrumentation amplifier, AC amplifier, V to I and I to V converters, Integrator and differentiator.

NON-LINEAR APPLICATIONS OF OP-AMP: Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multivibrators, Triangular and Square waveformgenerators, Oscillators

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

- Understand the concepts of integrator & differentiator circuits (L2)
- Understand the concepts of multivibrators and waveform generators (L2)
- Develop the output voltage expression for instrumentation amplifier (L3)
- Analyze the adder, subtractors, multiplier and divider circuits (L4)

UNIT – III (10 Hrs)

ACTIVE FILTERS: Introduction, Butterworth filters – 1^{st} order, 2^{nd} order low pass and high pass filters, band pass, band reject and all pass filters.

TIMERS AND REGULATORS: Introduction to IC 555 timer, description of functional diagram, monostable and astable operations and applications, Schmitt trigger, Introduction-Series Op-Amp regulator, IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator.

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

- Develop knowledge on 1st and 2nd order active filters. (L3)
- Understand the functionality of 555 timer. (L2)
- Understand the internal structure and functionality of voltage regulators (L2)

UNIT – IV (8 Hrs)

COMBINATIONAL CIRCUITS USING TTL 74XX ICS: Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483), Comparator (IC 7485), Decoder (IC74138, IC 74154), BCD-to-7- segment decoder (IC 7447), Encoder (IC 74147), Multiplexer (IC 74151), Demultiplexer (IC74154).

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

- Develop knowledge on the working of various combinational circuit ICs. (L3)
- Develop higher order combinational circuits from lower order Combinational ICs. (L3)

UNIT – V (9 Hrs)

SEQUENTIAL CIRCUITS USING TTL 74XX ICS: Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194), 4- bit asynchronous binary counter (IC 7493), Memory -SRAM & DRAM.

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

- Understand the working of sequential circuits using TTL ICs. (L2)

- Develop higher order Sequential circuits from lower order Sequential ICs. (L3)

TEXTBOOKS:

1. "Linear Integrated Circuit", D. Roy Choudhury, Shail B. Jain, New Age International Pvt.Ltd., New Delhi, India, 4th Edition, 2012
2. "OP-AMP and Linear Integrated Circuits", Ramakant A. Gayakwad, Prentice Hall / Pearson Education, New Delhi, 4th Edition, 2012
3. "Digital Fundamentals", Floyd, Jain, Pearson Education, New Delhi, 8th Edition, 2009.

REFERENCE BOOKS:

1. "Design with operational amplifiers and analog integrated circuits", Sergio Franco McGrawHill, New Delhi, 1997
2. "Digital Design Principles and Practices", John F Wakerly, Pearson Education, 4th Edition

Course Code	INTRODUCTION TO SIGNAL PROCESSING		L	T	P	C
21A040502			3	0	0	3
Pre-requisite	NIL	Semester	V			

COURSE OBJECTIVES:

- To understand, represent and classify continuous time and discrete time signals and systems, together with the representation of LTI systems.
- To represent continuous time signals (both periodic and non-periodic) in the time domain, s-domain and the frequency domain.
- To understand the properties of analog filters, and have the ability to design Butterworth filters.
- To understand and apply sampling theorem and convert a signal from continuous time to discrete time and able to represent the discrete time signal in the frequency domain.
- To understand FIR and IIR filters to meet given specifications.

COURSE OUTCOMES:

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

CO1: Explain continuous time and discrete time signals and systems, in time and frequency domain. **(K3)**

CO2: Apply Fourier series and Fourier Transform to analyze periodic & non-periodic signals and their spectra. **(K3)**

CO3: Design and implement the analog filter using components/suitable simulation tools. **(K4)**

CO4: Apply sampling theorem and convert a signal from continuous time to discrete time or from discrete time to continuous time. **(K3)**

CO5: Design and implement the digital filter using suitable simulation tools. **(K4)**

CO-PO MAPPING:

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

UNIT – I (9 Hrs)

Introduction to Signals & Systems: Signal Definition, Signal Classification, System definition, System classification for both continuous time and discrete time, Basic Operations on Signals, Elementary Signals & Sequences, Definition of LTI systems, Transfer function of a LTI system, Concepts of Convolution and Correlation of signals, Illustrative Problems.

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

- Understand different basic types of signals and systems. (L2)

- Understand various basic operations on signals and elementary signals. (L2)
- Describe continuous time signal and discrete time signal. (L2)
- Sketch the various types of basic signals for both continuous time & discrete time. (L3)
- Understand the LTI systems, convolution & correlation of signals. (L2)

UNIT – II (10 Hrs)

Fourier Series & Transform: Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems, Fourier Transform of arbitrary signal, Properties of Fourier Transform, Illustrative Problems.

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

- Analyze the periodic signals by applying Fourier series. (L4)
- Apply Fourier transform to solve problems. (L3)
- Analyze the spectral characteristics of signals. (L4)

UNIT – III (8 Hrs)

Analog Filters: Frequency response of ideal analog filters, Salient features of Butterworth filters Design and implementation of Analog Butterworth filters to meet given specifications, Illustrative Problems.

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

- Understand the importance of analog filters. (L2)
- Design and implement the analog Butterworth filters. (L4)

UNIT – IV (8Hrs)

Sampling Theorem & DFT: Sampling Theorem- Statement and proof, converting the analog signal to a digital signal, Practical sampling, The Discrete Fourier Transform, Properties of DFT, IDFT, Comparing the frequency response of analog and digital systems, Illustrative Problems.

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

- Understand the importance of sampling techniques. (L2)
- Illustrate signal sampling and its reconstruction. (L3)
- Explain the importance of discrete Fourier transform. (L3)

UNIT – V (10Hrs)

Digital Filters: Characteristics of FIR and IIR filters. Frequency response of ideal digital filters, Transforming the Analog Butterworth filter to the Digital IIR Filter using suitable mapping techniques, to meet given specifications. Design of FIR Filters using the Window technique, Comparison of FIR & IIR, Illustrative Problems.

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

- Understand the importance of IIR and FIR digital Filters. (L2)
- Analyze windowing techniques in FIR filters. (L4)

- Illustrate the digital filters of different techniques. (L3)
- Design IIR and FIR filters. (L4)

TEXTBOOKS:

1. "Signals, Systems and Communications", B. P. Lathi, BS Publications, 2008.
2. "Digital signal processing, principles, Algorithms and applications", John G. Proakis, Dimitris G. Manolakis, Pearson Education/PHI, 4th Edition, 2007.
3. "Discrete Time Signal Processing", A. V. Oppenheim and R.W. Schaffer, PHI, 2009.

REFERENCE BOOKS:

1. "Linear Systems and Signals", B. P. Lathi, Oxford University press, 2nd Edition.
2. "Digital Signal Processing – Fundamentals and Applications", Li Tan, Elsevier, 2008.
3. "Signals, Systems and Transforms", C. L. Philips, J. M. Parr and Eve A. Riskin, PE, 3rd Edition, 2004.
4. "Signals and Systems", A.V. Oppenheim, A.S. Willsky and S. H. Nawab, PHI, 2nd Edition, 2013.
5. "Signals and Systems", A. Anand Kumar, PHI Publications, 3rd Edition, 2013.

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, 6th Edition, 2006.
2. "Structured Computer Organization", Andrew S. Tanenbaum, Pearson, 4th 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)

UNIT – II (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)

UNIT – III (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)

UNIT – IV (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)

UNIT – V (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	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	PRINCIPLES OF COMMUNICATION SYSTEMS		L	T	P	C
21A040503			3	0	0	3
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- To understand the concept of various modulation schemes and multiplexing.
- To apply the concept of various modulation schemes to solve engineering problems.
- To analyse various modulation schemes.
- To evaluate various modulation scheme in real time applications.

COURSE OUTCOMES:

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

CO1: Apply the concept of amplitude modulation to solve engineering problems. **(K3)**
CO2: Analyze the Angle modulation & demodulation systems in time & frequency domains. **(K4)**
CO3: Analyze different Analog Pulse modulation & demodulation techniques. **(K4)**
CO4: Explain various digital modulation schemes. **(K3)**
CO5: Understand the concept of various communication systems. **(K2)**

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 (10 Hrs)

Amplitude Modulation: An overview of Electronic Communication Systems. Need for Frequency Translation, Amplitude Modulation: DSB-FC, DSB-SC, SSB-SC and VSB. Frequency Division Multiplexing. Radio Transmitter and Receiver.

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

- Understand the concept of noise, Fourier transform, career modulation and frequency division multiplexing. (L2)
- Apply the concept of amplitude modulation to solve engineering problems. (L3)

UNIT – II (9 Hrs)

Angle Modulation: Angle Modulation, Tone modulated FM Signal, Arbitrary Modulated FM Signal, FM Modulation and Demodulation. Stereophonic FM Broadcasting.

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

- Understand the concept of angle modulation and its components. (L2)
- Apply the concept of frequency modulation to solve engineering problems. (L3)
- Analyse angle modulation schemes. (L4)
- Evaluate frequency modulation scheme in real time applications. (L4)

UNIT – III (8 Hrs)

Pulse Modulation: Sampling Theorem: Low pass and Band pass Signals. Pulse Amplitude Modulation and Concept of Time Division Multiplexing. Pulse Width Modulation. Digital Representation of Analog Signals.

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

- Understand the concept of various pulse modulation schemes and time division multiplexing. (L2)
- Explain various pulse modulation schemes. (L4)

UNIT – IV (9 Hrs)

Digital Modulation: Binary Amplitude Shift Keying, Binary Phase Shift Keying and Quadrature Phase Shift Keying, Binary Frequency Shift Keying. Regenerative Repeater.

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

- Understand the concept of various digital modulation schemes. (L2)
- Analyze various digital modulation schemes. (L4)

UNIT – V (9 Hrs)

Communication Systems: Satellite, RADAR, Optical, Mobile and Computer Communication (Block diagram approach only).

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

- Understand the concept of various communication systems. (L2)

Note: The main emphasis is on qualitative treatment. Complex mathematical treatment may be avoided.

TEXTBOOKS:

1. "Principles of Communication Systems", Herbert Taub, Donald L Schilling and Goutam Saha, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., 2008.

REFERENCE BOOKS:

1. "Modern Digital and Analog Communication Systems", B. P. Lathi, Zhi Ding and Hari M. Gupta, 4th Edition, Oxford University Press, 2017.
2. "Digital and Analog Communication Systems", K. Sam Shanmugam, Wiley India Edition, 2008.

ONLINE LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108104091
2. https://www.eeeguide.com/principles-of-communication-systems
3. https://ncert.nic.in/ncerts/l/leph207.pdf

Course Code	ELECTRONIC INSTRUMENTATION		L	T	P	C
21A040504			3	0	0	3
Pre-requisite	NIL	Semester	VI			

COURSE OBJECTIVES:

- To introduce various measuring instruments and their functionality.
- To teach various measurement metrics for performance analysis.
- To explain principles of operation and working of different electronic instruments.
- To familiarize the characteristics, operations, calibrations and applications of the different oscilloscopes and signal generators.
- To provide exposure to different types of transducers.

COURSE OUTCOMES:

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

CO1: Understand the different methods for measurement of various electrical quantities. **(K2)**
CO2: Compare the various measuring techniques for measuring voltage. **(K4)**
CO3: Measure amplitude and frequency utilizing oscilloscopes. **(K5)**
CO4: Analyze the functioning of various types of probes, derive the balanced condition for various bridges. **(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	2	2	-	-	-	-	-	-	-	-	-	3	3	2
CO2	3	3	-	-	-	-	-	-	-	-	-	3	3	2
CO3	3	3	-	-	-	-	-	-	-	-	-	3	3	2
CO4	3	3	-	-	-	-	-	-	-	-	-	3	3	2
CO5	3	3	-	-	-	-	-	-	-	-	-	3	3	2

UNIT – I (10 Hrs)

Measurement and Error: Definitions, Accuracy, Precision, Resolution and Significant Figures, Types of Errors, Measurement error combinations. **Ammeters:** DC Ammeter, Multi-range Ammeter, The Ayrton Shunt or Universal Shunt, Requirements of Shunt, Extending of Ammeter Ranges, RF Ammeter (Thermocouple), Limitations of Thermocouple. **Voltmeters and Multi-meters:** Introduction, Basic Meter as a DC Voltmeter, DC Voltmeter, Multi range Voltmeter, Extending Voltmeter Ranges, Loading, AC Voltmeter using Rectifiers. True RMS Voltmeter, Multi-meter.

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

- Understand the importance of measurement system. (L2)
- Explain the characteristics of different Instruments. (L2)

- Illustrate different types of errors that may occur in instruments during measurements. (L2)

UNIT – II (9 Hrs)

Digital Voltmeters: Introduction, RAMP technique, Dual Slope Integrating Type DVM, Integrating Type DVM, Most Commonly used principles of ADC, Successive Approximations, Digit, Resolution and Sensitivity of Digital Meters, General Specifications of DVM.

Digital Instruments: Introduction, Digital Multi-meters, Digital Frequency Meter, Digital Measurement of Time, Universal Counter, Digital Tachometer, Digital pH Meter, Digital Phase Meter, Digital Capacitance Meter.

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

- Explain working of digital measuring Instruments. (L2)
- Compare the various measuring techniques for measuring voltage. (L4)

UNIT – III (9 Hrs)

Oscilloscopes: Introduction, Basic principles, CRT features, Block diagram of Oscilloscope, Simple CRO, Vertical Amplifier, Horizontal Deflecting System, Sweep or Time Base Generator, Measurement of Frequency by Lissajous Method, Digital Storage Oscilloscope.

Signal Generators: Introduction, Fixed and Variable AF Oscillator, Standard Signal Generator, Laboratory Type Signal Generator, AF sine and Square Wave Generator, Function Generator.

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

- Measure parameters viz. Amplitude, frequency and time period using CRO. (L5)
- Classify signal generators and describe its characteristics. (L2)

UNIT – IV (8 Hrs)

Measuring Instruments: Field Strength Meter, Stroboscope, Phase Meter, Q Meter, Megger.

Bridges: Introduction, Wheatstone‘s bridge, Kelvin‘s Bridge; AC bridges, Capacitance Comparison Bridge, Inductance Comparison Bridge, Maxwell‘s bridge, Wien‘s bridge.

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

- Describe function of various measuring Instruments. (L2)
- Describe how unknown capacitance and inductance can be measured using bridges. (L2)
- Select appropriate bridge for measuring R, L and C parameters. (L2)
- Analyze the functioning of various types of probes derive the balanced condition for various bridges. (L4)

UNIT – V (9 Hrs)

Transducers: Introduction, Electrical transducers, Selecting a transducer, Resistive transducer, Resistive position transducer, Strain gauges, Resistance thermometer, Thermistor, Inductive transducer, LVDT, Piezoelectric transducer, Photo cell, Photo voltaic cell, Semiconductor photo diode and transistor.

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

- Explain the importance of transducer. (L2)
- Measure various physical parameters by appropriately selecting the transducers. (L5)

TEXTBOOKS:

1. "Electronic Instrumentation", H. S. Kalsi, McGraw Hill, 3rd Edition, 2012, ISBN: 9780070702066.
2. "Modern Electronic Instrumentation and Measuring Techniques", A. D. Helfrick and W.D. Cooper, Pearson, 1st Edition, 2015, ISBN: 9789332556065.

REFERENCE BOOKS:

1. "Electronic Instrumentation & Measurements", David A. Bell, Oxford University Press PHI 2nd Edition, 2006 ISBN 81-203-2360-2.
2. "Electronics and Electrical Measurements", A. K. Sawhney, Dhanpat Rai &Sons. ISBN - 81-7700-016-0

ONLINE LEARNING RESOURCES:

1. http://nptel.ac.in/courses/108105064/
2. http://nptel.ac.in/courses/108105062/

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	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	ELECTRONIC SENSORS		L	T	P	C
21A040505			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To learn the characterization of sensors.
- To know the working of Electromechanical, Thermal, Magnetic and radiation sensors
- To understand the concepts of Electro analytic and smart sensors
- To be able to use sensors in different applications.

COURSE OUTCOMES:

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

CO1: Explain the Principles of different sensors, Characterization and working of Electro mechanical Sensors. **(K3)**

CO2: Analyze the working of Thermal sensors. **(K4)**

CO3: Compare the working of magnetic resistor and hall effect sensors. **(K4)**

CO4: Explain the working of radiation and Electro analytic Sensors. **(K3)**

CO5: Develop a system with smart sensors. **(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	3	-	-	-	-	-	-	-	-	-	3	3	2

UNIT – I (9 Hrs)

Sensors / Transducers: Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization.

Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges - Inductive Sensors: Sensitivity and Linearity of the Sensor – Types-Capacitive Sensors: Electrostatic Transducer, Force/Stress Sensors Using Quartz Resonators, Ultrasonic Sensors.

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

- Understand the concepts of sensors/Transducers principles. (L2)
- Understand the concepts of Electro mechanical sensors. (L2)
- Identify the operation of Inductive and capacitive sensors. (L3)

UNIT – II (9 Hrs)

Thermal Sensors: Introduction, Gas thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor, Dielectric Constant and Refractive Index thermo sensors, Helium Low Temperature Thermometer, Nuclear Thermometer, Magnetic Thermometer, Resistance Change Type Thermometric Sensors, Thermo emf Sensors, Junction Semiconductor Types, Thermal Radiation Sensors, Quartz Crystal Thermoelectric Sensors, NQR Thermometry, Spectroscopic Thermometry, Noise Thermometry, Heat Flux Sensors.

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

- Understand the concepts of Thermal sensors. (L2)
- Understand the working of Thermal radiation sensors. (L2)
- Identify the types of semiconductor sensors. (L3)
- Analyse the operation of heat flux sensors. (L4)

UNIT – III (9 Hrs)

Magnetic sensors: Introduction, Sensors and the Principles Behind, Magneto-resistive Sensors, Anisotropic Magneto resistive Sensing, Semiconductor Magneto resistors, Hall Effect and Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers, Synchros.

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

- Understand the principles of Magnetic sensors. (L2)
- Summarize the concepts of Angular transducers. (L2)
- Compare the working of magnetic resistor and Hall effect sensors. (L4)

UNIT – IV (9 Hrs)

Radiation Sensors: Introduction, Basic Characteristics, Types of Photo resistors/ Photo detectors, Xray and Nuclear Radiation Sensors, Fibre Optic Sensors, Electro analytical Sensors: The Electrochemical Cell, The Cell Potential - Standard Hydrogen Electrode (SHE), Liquid Junction and Other Potentials, Polarization, Concentration Polarization, Reference Electrodes, Sensor Electrodes, Electro ceramics in Gas Media.

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

- Understand the concepts of radiation sensors. (L2)
- Summarize the types of photo detectors. (L2)
- Explain different electrodes and sensors. (L3)

UNIT – V (9 Hrs)

Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing - Data Communication, Standards for Smart Sensor Interface, the Automation Sensors –Applications, Introduction- On-board Automobile

Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing – Sensors for environmental Monitoring.

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

- Understand the concepts of smart sensors. (L2)
- Summarize the applications of automation sensor. (L2)
- Develop different sensors used in the industries and manufacturing. (L3)

TEXTBOOKS:

1. "Sensors and Transducers", D. Patranabis, PHI Learning Private Limited., 2003.
2. "Introduction to sensors", John veteline, Aravind Raghu, CRC press, 2011

REFERENCE BOOKS:

1. "Sensors and Actuators", D. Patranabis, PHI, 2nd Edition, 2013.
2. "Make sensors", Tero Karvinen, Kimmo Karvinen and Ville Valtokari, Maker media, 1st Edition, 2014.
3. "Sensors handbook", Sabrie Soloman, TMH, 2nd Edition, 2009

ONLINE LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108108147
2. http://www.nitttrc.edu.in/nptel/courses/video/101104066/101104066.html

Course Code	INTRODUCTION TO IMAGE PROCESSING		L	T	P	C
21A040506			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To introduce fundamentals of Image Processing.
- To expose various intensity transformations in spatial and frequency domains.
- To impart concepts of wavelets and various coding techniques for image compression.
- To dissimilate various segmentation techniques for images.
- To teach various color models and to introduce the concepts of color image segmentation.

COURSE OUTCOMES:

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

CO1: Analyze various types of images mathematically. **(K4)**
CO2: Compare image enhancement methods in spatial and frequency domains. **(K3)**
CO3: Apply various segmentation algorithms for processing an image. **(K3)**
CO4: Categorize various compression techniques and color models. **(K4)**
CO5: Apply various techniques for color image smoothing, sharpening and segmentation. **(K3)**

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 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, two-dimensional DFT and its inverse, 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. (L3)

UNIT – III (9 Hrs)

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

- Describe various Image segmentation techniques. (L2)
- Illustrate detection of discontinuities in an image. (L2)
- Apply various segmentation algorithms for processing an image. (L3)

UNIT – IV (9 Hrs)

Image Compression: Redundancy, inter-pixel and psycho-visual; Loss less compression-predictive, entropy; Lossy compression- predictive and transform coding; Discrete Cosine Transform; Still image compression standards – JPEG and JPEG-2000.

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

- Describe various transform techniques for lossy compression. (L2)
- Apply various coding techniques for lossless compression. (L3)

UNIT – V (9 Hrs)

Color Image Processing: Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

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

- Describe various color models for color image processing. (L2)
- Apply various techniques for color image smoothing, sharpening and segmentation. (L3)

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	INRODUCTION 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)

UNIT – III (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)

UNIT – IV (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)

UNIT – V (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)

TEXTBOOKS:

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

REFERENCE BOOKS:

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	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 : [redacted] - 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: [redacted] - 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)

UNIT – III (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)

UNIT – IV (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)

UNIT – V (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)

TEXTBOOKS:

1. "Total Quality Management", D.R.Kiran, BS Publications, 2016
2. "Total Quality Management", Bester field, Pearson.

REFERENCE BOOKS:

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	PRINCIPLES OF CELLULAR AND MOBILE COMMUNICATIONS		L	T	P	C
21A040507			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To understand the concepts and operation of cellular systems.
- To apply the concepts of cellular systems to solve engineering problems.
- To analyze cellular systems for meaningful conclusions.
- 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: Understand the concepts and operation of cellular systems. **(K2)**

CO2: Apply the concepts of co-channel interference & Cell splitting to solve engineering problems. **(K3)**

CO3: Compare different Handoffs. **(K4)**

CO4: Compare various types of multiple access techniques. **(K4)**

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	2	2	-	-	-	-	-	-	-	-	-	3	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO3	3	3	2	-	-	-	-	-	-	-	-	3	3	2
CO4	3	3	2	-	-	-	-	-	-	-	-	3	3	2
CO5	3	3	2	-	-	-	-	-	-	-	-	3	3	3

UNIT – I (10 Hrs)

Introduction to Cellular Mobile Systems: Why cellular mobile communication systems? A basic cellular system, Evolution of mobile radio communications, Performance criteria, Characteristics of mobile radio environment, Operation of cellular systems. Examples for analog and digital cellular systems.

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

- Understand the concepts and operation of cellular systems. (L2)
- Explain the characteristics of mobile radio environment. (L2)

UNIT – II (8 Hrs)

Cellular Radio System Design: General description of the problem, Concept of frequency reuse channels, Co-channel interference reduction, Desired C/I ratio, Cell splitting and sectoring, Microcell zone concept.

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

- Understand the concept of frequency reuse and co-channel interference in cellular systems. (L2)
- Apply the concept of cellular systems to solve engineering problems. (L3)
- Explain the design problems of cellular systems. (L3)

UNIT – III (10 Hrs)

Handoffs and Dropped Calls: Why handoffs and types of handoffs, Initiation of handoff, Delaying a handoff, Forced handoffs, Queuing of handoffs, Power-difference handoffs, Mobile assisted handoff and soft handoff, Cell-site handoff, Inter system handoff. Introduction to dropped call rate.

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

- Understand why handoff is required. (L2)
- Apply handoff techniques to solve engineering problems. (L3)
- Compare various types of handoffs. (L4)

UNIT – IV (8 Hrs)

Multiple Access Techniques for Wireless Communications: Introduction, Frequency Division Multiple Access, Time Division Multiple Access, Code Division Multiple Access and Space Division Multiple Access.

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

- Understand various types of multiple access techniques. (L2)
- Apply the concept of multiple access to solve engineering problems. (L3)
- Compare various types of multiple access techniques. (L4)

UNIT – V (9 Hrs)

Digital Cellular Systems: Global System for Mobile Systems, Time Division Multiple Access Systems, Code Division Multiple Access Systems. Examples for 2G, 3G and 4G systems. Introduction to 5G system.

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

- Understand operation of various types of digital cellular systems. (L2)
- Compare various types of digital cellular systems. (L2)
- Evaluate suitability of a cellular system in real time applications. (L4)

Note: The main emphasis is on qualitative treatment. Complex mathematical treatment may be avoided.

TEXTBOOKS:

1. "Mobile Cellular Tele communications", William C.Y.Lee, McGraw – Hill International, 2 nd Edition, 1995.
2. "Wireless Communications–Principles and Practice", Theodore S. Rappaport, PHI, 2nd Edition, 2004.

REFERENCE BOOKS:

1. "Principles of Modern Wireless Communications Systems –Theory and Practice", Aditya K. Jagannatham, McGraw – Hill International, 2015.

ONLINE LEARNING RESOURCES:

1. https://nptel.ac.in/courses/117102062
2. https://www.electronicshub.org/wireless-communication-introduction-types-applications/

Course Code	EMBEDDED SYSTEMS		L	T	P	C
21A040508			3	0	0	3
Pre-requisite	NIL	Semester	VII			

COURSE OBJECTIVES:

- To understand the basics of an embedded system
- To introduce the typical components of an embedded system
- To explain various communication interfaces used in 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: Discuss the basic concepts of an embedded system. **(K3)**

CO2: Explainthe role of system core, memory, sensors, actuators, I/O and other sub system components in an embedded system. **(K3)**

CO3: Explain the different communication interfaces of an embedded system. **(K3)**

CO4: Illustrate about the interrupt service mechanism and device drivers. **(K3)**

CO5: Write aboutvarious steps involved in design and development of embedded firmware. **(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	2	-	-	-	-	-	-	-	-	-	3	-	3
CO4	3	2	-	-	-	-	-	-	-	-	-	3	-	3
CO5	3	2	-	-	-	-	-	-	-	-	-	3	-	3

UNIT – I (9 Hrs)

Introduction to Embedded Systems: Definition, Embedded systems Vs General computing 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, Memory-ROM, RAM, 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, PCB and passive components

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 the 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)

UNIT – IV (9 Hrs)

Device drivers and Interrupt Service Mechanism: Programmed I/O busy-wait approach without interrupt service mechanism, Interrupt-driven I/O, interrupt service routine concept, interrupt sources, hardware interrupts, software interrupts, interrupt-servicing mechanism, multiple interrupts, interrupt service threads as second-level interrupt handlers, context and the periods for context switching, interrupt latency, interrupt-service deadline, interrupt service mechanism form context-saving angle, Device driver programming.

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

- Summarize pros and cons of interrupt driven data transfer. (L2)
- Illustrate hardware and software interrupts with examples. (L3)
- Know how interrupts can be used to minimize latency. (L3)
- Describe uses of hardware and software assigned priorities in an interrupt service mechanism. (L2)
- Differentiate ISRs & device driver functions. (L2)

UNIT – V (8 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)
- Write about various steps involved in design and development of embedded firmware. (L3)

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	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 POWER SEMICONDUCTOR DEVICES		L	T	P	C
21A02HN01			3	1	0	4
Pre-requisite	NIL	Semester	-			

COURSE OBJECTIVES:

- To understand the static and dynamic characteristics of current controlled power semiconductor devices.
- To understand the static and dynamic characteristics of voltage-controlled power semiconductor devices.
- To enable the students for the selection of devices for different power electronics applications.
- To understand the control and firing circuit for different devices.

COURSE OUTCOMES:

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

CO1: Choose appropriate power electronic device for a particular converter topology. **(K3)**
CO2: Analyze the principle of various current controlled power electronics devices. **(K4)**
CO3: Analyze the principle of various voltage controlled power electronics devices. **(K4)**
CO4: Describe the firing and protection of the power semiconductor devices. **(K3)**
CO5: Analyze the thermal protection of power semiconductor devices. **(K4)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Introduction: Power switching devices, overview – Attributes of an ideal switch, application requirements, Device selection strategy – On-state and switching losses –Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

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

- Understand the various power electronic switches and its characteristics (L2)
- Analyze the operating characteristics of power semiconductor switches (L4)

UNIT – II (12 Hrs)

Current Controlled Devices: BJT's – Construction, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power darlington – Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy

– concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation.

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

- Understand the current controlled power electronic devices along with its characteristics (L2)
- Analyze the various transistor analogy and its characteristics (L4)

UNIT – III (12 Hrs)

Voltage Controlled Devices: Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady-state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT (Mos Controlled Thyristor), FCT (Field Controlled Thyristor), RCT (Reverse Conducting Thyristor) .

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

- Understand the voltage controlled power electronic devices along with its characteristics (L2)
- Analyze the various steady state and dynamic models of voltage controlled devices (L4)

UNIT – IV (10 Hrs)

Firing and Protecting Circuits: Necessity of isolation, pulse transformer, optocopler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers.

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

- Understand the firing circuits for the various power semiconductor devices (L2)
- Analyze various the protection circuits for power semiconductor devices (L3)

UNIT – V (10 Hrs)

Thermal Protection: Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design.

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

- Understand the various heat transfer techniques in power semiconductor devices (L3)
- Analyze the behaviour of heat sink and types and design of heat sinks (L3)

TEXTBOOKS:

1. "Power Electronics Circuits, Devices and Applications", Rashid M. H., Prentice Hall India, Third Edition, New Delhi.
2. "Power Electronics: Devices, Drivers, Applications and Passive Components", B.W. Williams Tata McGraw Hill.

REFERENCE BOOKS:

1. "Advanced power electronics converters", Euzeli dos santos, Edison R. da silva.
2. "Fundamentals of Power Semiconductor Devices", B. Jayanth Baliga, Springer Press, 2008.

Course Code	APPLICATIONS OF POWER ELECTRONICS TO POWER SYSTEMS		L	T	P	C
21A02HN02			3	1	0	4
Pre-requisite	NIL	Semester	-			

COURSE OBJECTIVES:

- To develop the understanding of uncompensated lines and their behaviour under heavy loading conditions.
- To understand the concept and importance controllable parameters of FACTS controllers.
- To emphasize the objectives of Shunt compensation, and basic operation of SVC and STATCOM.

COURSE OUTCOMES:

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

CO1: Understand Transmission interconnection, Power flow in transmission system, Dynamic stability, shunt series compensation and FACT Devices **(K2)**

CO2: Analyze midpoint voltage regulation, Prevention of Voltage instability, Transient stability improvement, Static VAR compensator SVC and STATCOM **(K4)**

CO3: Describe the objectives of Series Compensation, voltage stability, improvement of transient stability, power oscillation damping, Thyristor controlled series controlled capacitors, SSSC.**(K3)**

CO4: Understands UPFC, independent real and reactive power flow control, basic control system for P and Q control.**(K2)**

CO5: Apply the power quality problems, harmonics, loads creating harmonics, harmonic power flow and mitigation, passive filters, active filters, shunt, series and hybrid filters.**(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	2
CO2	3	2	2	2	-	2	-	-	-	-	-	-	3	2
CO3	3	2	3	2	-	2	-	-	-	-	-	-	3	2
CO4	3	2	2	2	-	2	-	-	-	-	-	-	3	2
CO5	3	3	2	2	-	2	-	-	-	-	-	-	3	2

UNIT – I (10 Hrs)

General System considerations and FACTS: Transmission Interconnections, Flow of Power in an AC System, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, principles of series and shunt compensation, Basic Types of FACTS Controllers, Benefits from FACTS, Application of FACTS.

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

- Understand Transmission interconnection, Power flow in transmission system, Dynamic stability (L2)
- Analyze shunt series compensation and FACT Devices (L4)

UNIT – II (12 Hrs)

Shunt Compensators: Objectives of Shunt Compensation, Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, improvement of Transient Stability, Power Oscillation Damping, Static VAR Compensators, SVC and STATCOM, The Regulation Slope, Transfer Function and dynamic Performance, Transient Stability, Enhancement and Power Oscillation Damping

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

- Understands Midpoint voltage regulation, Prevention of Voltage instability, Transient stability Improvement (L2)
- Analyze the Static VAR compensator SVC and STATCOM Enhancement of Power oscillation Damping (L4)

UNIT – III (10 Hrs)

Series Compensators: Objectives of Series Compensation, concept of series capacitive compensation, voltage stability, improvement of transient stability, power oscillation damping, GTO thyristor-controlled series capacitor, Thyristor controlled series capacitor, SSSC.

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

- Understand objectives of Series Compensation, voltage stability, improvement of transient stability, power oscillation damping (L2)
- Analyze the Thyristor controlled series controlled capacitors, SSSC. (L4)

UNIT – IV (10 Hrs)

Combined Compensators: Introduction, Unified power flow controller, basic operating principles, independent real and reactive power flow control, and control structure, basic control system for P and Q control.

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

- Understand UPFC, Independent real and reactive power flow control (L2)
- Analyze basic control system for P and Q control (L4)

UNIT – V (10 Hrs)

Mitigation of Harmonics: Power quality problems, harmonics, harmonic creating loads, harmonic power flow, and mitigation of harmonics, filters, passive filters, active filters, shunt, series and hybrid filters.

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

- Understands Power quality problems, harmonics, loads creating harmonics, harmonic power flow and mitigation (L2)
- Analyze the passive filters, active filters, shunt, series and hybrid filters.(L4)

TEXTBOOKS:

1. "Understanding FACTS", Narain G. Hingorani, Laszlo Gyugyi, IEEE press
2. "Electrical Power Systems Quality", Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H. Wayne Beaty, McGraw Hill,2003

REFERENCE BOOKS:

1. "Flexible A.C. Transmission System", Y. H. Song, A. T. Johns, IEE, London, 1999

Course Code	REACTIVE POWER COMPENSATION & MANAGEMENT		L	T	P	C
21A02HN03			3	1	0	4
Pre-requisite	NIL	Semester	-			

COURSE OBJECTIVES:

- To identify the necessity of reactive power compensation
- To describe load compensation
- To select various types of reactive power compensation in transmission systems
- To illustrate reactive power coordination system
- To characterize distribution side and utility side reactive power management.

COURSE OUTCOMES:

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

CO1: Distinguish the importance of load compensation in symmetrical as well as unsymmetrical loads. **(K3)**

CO2: Observe various compensation methods in transmission lines **(K2)**

CO3: Construct model for reactive power coordination and understand demand side reactive power management. **(K4)**

CO4: Distinguish Distribution & user side reactive power management **(K3)**

CO5: Understand the concept of Reactive power management in electric traction systems and arc furnaces. **(K2)**

CO-PO MAPPING:

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

UNIT – I (10 Hrs)

Load Compensation - Objectives and specifications – Reactive power characteristics – Inductive and capacitive approximate biasing – Load compensator as a voltage regulator – Phase balancing and power factor correction of unsymmetrical loads - Examples.

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

- Understand Reactive power characteristics (L2)
- Analyze voltage regulation and how to compensate it by Load compensator (L4)
- Solve phase balancing and power factor correction (L3)

UNIT – II (10 Hrs)

Steady – state & transient state reactive power compensation in transmission system - Uncompensated line – Types of compensation – Passive shunt and series and dynamic shunt compensation – Characteristic time periods – Passive shunt compensation – Static compensation - Series capacitor compensation – Compensation using synchronous condensers –Examples.

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

- Understand different Shunt compensation methods (L2)
- Analyze different Series compensation methods (L4)

UNIT – III (12 Hrs)

Reactive power coordination & demand side management - Objective – Mathematical modeling – Operation planning – Transmission benefits – Basic concepts of quality of power supply – Disturbances - Steady – state variations – Effects of under Voltages – Frequency – Harmonics, radio frequency and electromagnetic interferences. Load patterns – Basic methods - load shaping – Power tariffs - KVAR based tariffs - penalties for voltage flickers and Harmonic voltage levels.

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

- Solve and Modelling of Transmission system (L2)
- Discuss the various different Power quality Disturbances and their Effect (L3)
- Understand different shunt compensation methods (L2)
- Solve Problems on KVAR based tariffs (L3)

UNIT – IV (12 Hrs)

Distribution & user side reactive power management - System losses – Loss reduction methods – Examples – Reactive power planning – Objectives – Economics - Planning capacitor placement – Retrofitting of capacitor banks - KVAR requirements for domestic appliances – Purpose of using capacitors – Selection of capacitors – Deciding factors – Types of capacitors, characteristics and Limitations.

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

- Understand and Solving System loss reduction methods (L2)
- Analyze the Economics of Reactive power planning methods (L3)

UNIT – V (10 Hrs)

Reactive power management in electric traction systems and arc furnaces - Typical layout of traction systems – Reactive power control requirements – Distribution transformers - Electric arc furnaces – Furnaces transformer – Filter requirements – Remedial measures – Power factor of an arc furnace.

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

- Understand Reactive power management in electric traction systems (L2)

- Gain Knowledge on Different Electric Furnaces (L3)

TEXTBOOKS:

1. "Reactive Power Control in Electric Power Systems", J. E. Miller, John Wiley and Sons, 1982
2. "Reactive power Management", D. M. Tagare, Tata McGraw Hill, 2004.

Course Code	ENERGY EFFICIENT ELECTRICAL SYSTEMS		L	T	P	C
21A02HN04			3	1	0	4
Pre-requisite	NIL	Semester	-			

COURSE OBJECTIVES:

- To analyze the concepts of electricity billing and electrical load management.
- To understand the types of electrical products and systems that can lose energy.
- To learn how to measure energy loss.
- To know how to select and size equipment for the application.

COURSE OUTCOMES:

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

CO1: Understands about electricity billing, load management, maximum demand control, Power factor improvement and Distribution & transformer losses **(K2)**

CO2: Analyze different types of Motors, Losses, Efficiency, factors affecting performance of Motors Rewinding, Replacement and Energy saving methods **(K4)**

CO3: Identifies different types of lights, choice of lighting, illumination requirements and energy Efficient controls **(K3)**

CO4: Analyze the energy efficient, variable speed, smooth starting drives **(K4)**

CO5: Describe the various power Electronic Control systems **(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	2
CO2	3	2	2	2	-	2	-	-	-	-	-	-	3	2
CO3	3	2	3	2	-	2	-	-	-	-	-	-	3	2
CO4	3	2	2	2	-	2	-	-	-	-	-	-	3	2
CO5	3	2	2	2	-	2	-	-	-	-	-	-	3	2

UNIT – I (10 Hrs)

Electrical System: Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefits, Selection and location of capacitors, Performance assessment of PF capacitors, Distribution and transformer losses.

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

- Solve Problems on Electricity billing and on concept of maximum demand (L3)
- Understand optimal location of capacitors in power system for power factor correction. (L2)

UNIT – II (10 Hrs)

Electric Motors: Types, Losses in electric motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving methods in electric motors.

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

- Understand and solves problems on Losses, Efficiency of Motors (L2)
- Analyze rewinding and motor replacement and energy saving methods (L4)

UNIT – III (10 Hrs)

Lighting System: Light source, choice of lighting, illumination requirements, and energy conservation aspects. Energy efficient lighting controls, comparison of sodium vapor, halogen, CFL and LED lamps.

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

- Gain Knowledge on Choice of lighting, illumination requirements and energy conversion aspects (L2)
- Compare different Lights and understands Energy efficient lighting controls. (L3)

UNIT – IV (10 Hrs)

Electric Drives: Maximum demand controllers, energy efficient drives, soft-starters with energy saver, variable speed drives, energy efficient techniques in drives.

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

- Understand Energy efficient drives and soft starting techniques (L2)
- Gain knowledge on Variable speed drives and energy efficient techniques (L3)

UNIT – V (10 Hrs)

Power Electronic Systems: Automatic power factor controllers, electronic ballast, occupancy sensors, energy saving in power electronic controlled systems. Calculation of energy frequency ratio in the performance of star ratings

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

- Understand importance of automatic power factor controller, Electronic ballast and occupancy sensors (L2)
- Gain knowledge on power electronic controlled system and energy saving, Calculate Energy Frequency ratio (L3)

TEXTBOOKS:

1. "Energy Efficiency for Engineers and Technologists", Eastop T.D & Croft D.R, Logman Scientific & Technical, ISBN-0-582-03184, 1990.

REFERENCE BOOKS:

1. "Power System Engineering", D P Kothari, I J Nagrath, 2nd Edn., Tata McGraw-Hill Co 2008
2. Bureau of Energy Efficiency (BEE) : www.bee-india.nic.in
3. The Energy and Resource Institute (TERI): http://www.teriin.org/

4. “Energy Efficiency for Engineers and Technologists”, TD Eastop and DR Croft, First Edition, Longman Group UK Ltd., 1990.
5. www.bee-india.nic.in (Guide on Energy Efficient room Air conditioners)