SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. | www.svpcet.org

I B.TECH I SEMESTER – ELECTRICAL & ELECTRONICS ENGINEERING

S.No	Course Code	Course Title	Hours per Week			Credits
			L	T	P	
1	20BSBH01	Mathematics-I	2	1	0	3
2	20BSBH03	Applied Physics	3	0	0	3
3	20ES0501	Problem Solving Using 'C'	2	1	0	3
4	20HSBH01	Technical English	3	0	0	3
5	20ES0201	Electrical Circuits	3	0	0	3
6	20BSBH04	Applied Physics lab	0	0	3	1.5
7	20HSBH02	English Language and communication skills lab	0	0	3	1.5
8	20ES0502	Problem Solving Using 'C' lab	0	0	3	1.5
9		Induction Program				
		Total	**13**	**2**	**9**	**19.5**

I B.TECH II SEMESTER – ELECTRICAL & ELECTRONICS ENGINEERING

S.No	Course Code	Course Title	Hours per Week			Credits
			L	T	P	
1	20BSBH02	Mathematics-II	2	1	0	3
2	20BSBH07	Applied Chemistry	3	0	0	3
3	20ES0301	Engineering Graphics & Design	1	0	4	3
4	20ES0204	Network Analysis	3	0	0	3
5	20ES0503	Python Programming	3	0	0	3
6	20BSBH08	Applied Chemistry lab	0	0	3	1.5
7	20ES0504	Python Lab	0	0	3	1.5
8	20ES0302	Engineering Workshop & IT Practice	0	0	3	1.5
9	20MCBH01	Environmental Science (Mandatory Course)	0	0	0	0
		Total	**12**	**1**	**13**	**19.5**

SEMESTER – III
COURSE / BRANCH: B.TECH-ELECTRICAL & ELECTRONICS ENGINEERING

S.No	Course Code	Course Title	C	L	T	P	Credits
1	20BSBH12	Mathematics-III	BS	2	1	0	3
2	20PC0205	DC Machines & Transformers	C	3	0	0	3
3	20PC0401	Electronic Devices & Circuits	C	3	0	0	3
4	20PC0206	Electromagnetic Fields	C	3	0	0	3
5	20HSMB01	Economics for Engineers	HS	3	0	0	3
6	20PC0207	Network Theory Laboratory	V Lab	0	0	3	1.5
7	20PC0404	Electronic Devices & Circuit Laboratory	C Lab	0	0	3	1.5
8	20PC0208	DC Machines & Transformers Lab	C Lab	0	0	2	1.5
9	20SO0201	Circuits Simulation & Analysis using PSPICE & MATLAB	SOC	1	0	2	2
		Total					**21.5**
10	20MCBH02	Constitution of India	M	0	0	0	0

SEMESTER – IV
COURSE / BRANCH: B.TECH-ELECTRICAL & ELECTRONICS ENGINEERING

S.No.	Course Code	Course Title	C	L	T	P	Credits
1	20BSBH13	Mathematics-IV	BS	3	0	0	3
2	20ES0505	Data Structures and Algorithms with Python	ES	3	0	0	3
3	20PC0209	Power Systems-I	C	3	0	0	3
4	20PC0403	Digital Electronics	C	3	0	0	3
5	20PC0210	AC Machines	C	3	0	0	3
6	20PC0211	AC Machines lab	C Lab	0	0	3	1.5
7	20PC0212	Electrical Circuits & Simulation Lab	C Lab	0	0	3	1.5
8	20ES0506	Data Structures with Python lab	ES Lab	0	0	3	1.5
9	20SO0202	PLC Design	S	1	0	2	2

		Total					**21.5**
	20IN0201	Internship (Mandatory) for 6 weeks duration during summer vacation					

SEMESTER – V

COURSE / BRANCH: B.TECH-ELECTRICAL & ELECTRONICS ENGINEERING

S. No.	Course Code	Course Title	C	L	T	P	Credits
1	20PC0213	Power Systems II	PC	3	-	-	3
2	20PC0214	Power Electronics	PC	3	-	-	3
3	20PC0215	Control Systems	PC	3	-	-	3
4	20PE0201	Power Quality	PE/JOE-I	3	-	-	3
	20PE0202	Electrical Distribution Systems/MOOC					
	20PE0203	Programmable Logic Controllers					
	20PC0403	Signals and Systems					
5	XXXXXX	Open Elective - I	OE/JOE-I	3	-	-	3
6	20PC0216	Control Systems and simulation Lab	PC LAB	-	-	3	1.5
7	20PC0217	Power Electronics and simulation Lab	PC LAB	-	-	3	1.5
8	20SO0203	Soft Skills	SSC LAB	-	-	3	2
9	20IN0201	Internship	INTERSHIP	-	-	-	1.5
		Total		15	0	9	21.5

CATEGORY	
PC	12
OE	3
PE	3
INTERSHIP	1.5
SSC	2
TOTAL CREDITS	21.5

SEMESTER – VI

COURSE / BRANCH: B. TECH-ELECTRICAL & ELECTRONICS ENGINEERING

S. No.	Course Code	Course Title	C	L	T	P	Credits
1	20PC0218	Electrical Measurements and Instrumentation	PC	3	-	-	3
2	20PC0219	Power System Analysis	PC	3	-	-	3
3	20PC0414	Micro Processors and Micro Controllers	PC	3	-	-	3
4	20PE0204	Modern Control Theory	PE-II	3	-	-	3
	20PE0205	Industrial Automation and Control					
	20PE0206	Power Electronics and Distributed Generation					
	20PE0207	Power System Operation and Control					
5	XXXXXX	Open Elective – II	OE/JOE-II	3	-	-	3
6	20PC0220	Electrical Measurements and Instrumentation Laboratory	PC LAB	-	-	3	1.5
7	20PC0221	Computer Aided Design Laboratory	PC LAB	-	-	3	1.5
8	20PC0416	Micro Processors and Micro Controllers Lab	PC LAB	-	-	3	1.5
9	20SO0204	Skill Oriented Lab	SSC LAB	-	-	4	2
10	XXXXXX	Social Ethics		1	-	-	0
		Total		16	0	13	21.5

CATEGORY	
PC	13.5
OE	3
PE	3
SOC	2
TOTAL CREDITS	21.5

SEMESTER – VII

COURSE / BRANCH: B.TECH-ELECTRICAL & ELECTRONICS ENGINEERING

S. No.	Course Code	Course Title	C	L	T	P	Credits
1	20PE0208	Utilization of Electrical Energy	PE-III	3	-	-	3
	20PE0209	Power Systems Stability					
	20PE0210	High Voltage Engineering					
	20PE0211	Power System Transients					
2	20PE0212	Electrical Drives	PE-IV	3	-	-	3
	20PE0213	HVDC Transmission					
	20PE0214	Flexible Alternating Current Transmission Systems					
	20PE0215	Advanced Power System Protection					
3	20PE0216	Smart Grid Technology/ MOOC(Smart Grid- Basics to advanced technologies)	PE-V	3	-	-	3
	20PE0217	Energy Audit and Management					
	20PE0218	Digital Image Processing					
	20PE0219	Electric and Hybrid Vehicles					
4	XXXXXX	Open Elective – III/Software Engineering	OE- III	3	-	-	3
5	XXXXXX	Open Elective – IV/Introduction to Micro Electro Mechanical Systems	OE-IV	3	-	-	3
6	20MC0201	MOOC/Advanced Linear Continuous Control Systems	MOOC	3	-	-	3
8	20SO0205	Skill Oriented Lab	SSC LAB	-	-	4	2
9	20CV0201	Comprehension Vivo Voce	CVV	-	-	-	1
		Total		15	0	10	21

CATEGORY	
PE	12

OE	6
CVV	1
SOC	2
TOTAL CREDITS	21

SEMESTER – VIII

COURSE / BRANCH: B.TECH-ELECTRICAL & ELECTRONICS ENGINEERING

S. No.	Course Code	Course Title	C	L	T	P	Credits
1	20PR0201	PROJECT	PRO	07	-	07	14

OPEN ELECTIVE-I

S. No.	Course Code	Course Title
1	20OE0301	Introduction to Operation Management
2	20OE0302	Product Design
3	20OE0303	Energy Management
4	20OE0401	Digital Electronics and Microprocessor
5	20OE0402	Introduction to Communication Systems
6	20OE0403	Embedded Systems and its Applications
7	20OE0501	OOPS Using Java
8	20OE0502	Computer Organization
9	20OE0503	Design and Analysis of Algorithms

OPEN ELECTIVE-II

S. No.	Course Code	Course Title
1	20OE0304	Introduction to Vehicle Technology
2	20OE0305	Smart Materials
3	20OE0306	Optimization Techniques
4	20OE0404	Introduction to Networking
5	20OE0405	VLSI Design and its Applications
6	20OE0406	Introduction to IOT
7	20OE0504	Computer Networks
8	20OE0505	Object Oriented Analysis and Design
9	20OE0506	Database Management Systems

OPEN ELECTIVE-III

S. No.	Course Code	Course Title
1	20OE0307	Robotics
2	20OE0308	Nano Technology
3	20OE0309	Green Energy Systems
4	20OE0407	Industrial Nano Technology
5	20OE0408	Image Processing
6	20OE0409	Bio Medical Electronics
7	20OE0507	Operating System
8	20OE0508	Software Engineering
9	20OE0509	Human Computer Interaction

OPEN ELECTIVE-IV

S. No.	Course Code	Course Title
1	20OE0310	3D Printing Technology
2	20OE0311	Total Quality Management
3	20OE0312	Non-Destructive Testing
4	20OE0410	Digital Audio Engineering
5	20OE0411	Space Time Wireless Communications
6	20OE0412	Introduction to MEMS
7	20OE0510	Ethical Hacking
8	20OE0511	Machine Learning
9	20OE0512	Distributed Databases

OPEN ELECTIVES OFFERED BY DEPARTMENT TO OTHER BRANCH STUDENTS

OPEN ELECTIVE-I

S. No.	Course Code	Course Title
1	20OE0201	Renewable Energy Sources
2	20OE0202	Introduction to Power Electronics
3	20OE0203	Electrical Power Generation

OPEN ELECTIVE-II

S. No.	Course Code	Course Title
1	20OE0204	Introduction to High Voltage Engineering
2	20OE0205	Electrical Power Quality
3	20OE0206	Electrical Transmission System

OPEN ELECTIVE-III

S. No.	Course Code	Course Title

1	20OE0207	Introduction to Electrical Drives
2	20OE0208	Distribution Systems
3	20OE0209	Utilization and Traction Systems

OPEN ELECTIVE-IV

S. No.	Course Code	Course Title
1	20OE0210	Introduction to Power System Protection
2	20OE0211	Power System Analysis and Operation
3	20OE0212	Circuits and Synthesis

CREDIT DISTRIBUTION

S. No	Course	Hours	Credits
1	Theory Course (Core/Foundation/Elective)	3	3
2	Professional Core Courses	3	3
3	Professional Elective Courses	3	3
4	Open Elective Courses	3	3
5	Engineering Science courses (Engineering Graphics/Engineering Drawing)	1L+4P	3
6	Engineering Science courses	3	3
7	Laboratory Courses	3	1.5
8	Virtual Laboratory Courses	3	1.5
9	MOOC Courses	0	2
10	Skill Oriented Course / Certification Course	1L+2P	2
11	Skill Advanced Course / Certification Course	1L+2P	2
12	Soft Skill Course / Certification Course	1L+2P	2
13	Summer Internship (8 Weeks)	0	1.5
14	Comprehensive Viva Voce	0	1
15	Project Work, Seminar and Full Semester Internship in Industry (6 Months)	0	14
16	Mandatory Courses	2	0
17	Minor / Honors Degree Courses	4	4

CATEGORY WISE DISTRIBUTION OF CREDITS

S. No	Category	Subject Area and % of Credits	Average No. of Credits
1	Humanities and Social Sciences (HS), including Management.	HS (05% to 10%)	**10**
2	Basic Sciences (BS) including Mathematics, Physics and Chemistry.	BS (10% to 15%)	**21**
3	Engineering Sciences (ES), including Workshop, Drawing, Basics of Electrical / Electronics / Mechanical / Computer Engineering.	ES (10% to 15%)	**24**
4	Professional Subjects - Core (PC), relevant to the chosen specialization/branch.	PC (30% to 40%)	**51**
5	Professional Subjects - Electives (PE), relevant to the chosen specialization/branch.	PE (5% to 10%)	**15**
6	Open Electives Subjects / MOOCs - Electives (OE), from other technical and/or emerging subject areas.	OE (5% to 10%)	**12**
7	Project Work, Full Semester Internship and Summer Internships	5% to 10%	**17**
8	Skill Oriented Courses/Certificate Course	SO (2% to 3%)	**04**
9	Skill Advanced Courses / Certificate Course	SA (3% to 4%)	**06**
10	Mandatory Courses(Induction Program, NCC/NSS, Constitution of	MC (0%)	**0**

	India, Environmental Science, Social Values and Professional Ethics)		
TOTAL			**160**

OURSE COMPONENTS – SEMESTER WISE FOR FOUR YEAR REGULAR PROGRAMME

Year/Sem	No. of Theory Courses	No. of Lab Courses	Total Credits
B.Tech I Semester	2 Basic Science + 1 Humanities and Social Science + 2 Engineering Science	1 Humanities and Social Science Lab + 1 Basic Science Lab + 1 Engineering Science Lab + Induction Training (MC) + NCC / NSS (MC)	19.5
B.Tech II Semester	2 Basic Science + 3 Engineering Science	2 Engineering Science Lab + 1 Basic Science Lab + Environmental Science(MC)	19.5
B.Tech III Semester	1 Basic Science + 4 Professional Core	2 Professional Core Lab + 1 Professional Core Virtual Lab + Skill Oriented Course + Constitution of India (MC)	21.5
B.Tech IV Semester	3 Professional Core + 1 Engineering Science / Professional Core(Interdisciplinary) + Humanities and Social Science	Engineering Science / Professional Core(Interdisciplinary) Lab + 2 Professional Core Lab + Skill Oriented Course	21.5
B.Tech V Semester	3 Professional Core + Open Elective/ Job Oriented Elective -I + Professional Elective – I	2 Professional Core Lab + 1 Skill Advanced Course / Soft Skill Course + Summer Internship 2 Months after Second Year (To be Evaluated during V Semester)	21.5
B.Tech VI	3 Professional Core + Professional Elective - II + Open Elective/ Job	2 Professional Core Lab + 1 Professional Core Virtual Lab + 1 Skill Advanced	21.5

Semester	Oriented Elective – II	Course / Soft Skill Course + Social Values and Professional Ethics(MC)	
B.Tech VII Semester	3 Professional Elective-III,IV,V + Open Elective/ Job Oriented Elective –III, IV	2 Professional Core Lab + 1 Skill Advanced Course / Soft Skill Course + Comprehensive Viva Voce	21
B.Tech VIII Semester	Project Work , Seminar and Internship (6 Months)		14
Total	5 Basic Science + 2 Humanities and Social Sciences + 5 Engineering Science + 13 Professional Core + 1 Professional Core(Interdisciplinary) + 5 Professional Electives + 4 Open Electives / Job Oriented Electives + Project Work , Seminar and Internship (6 Months)	1 Humanities and Social Sciences Lab + 2 Basic Science Lab + 3 Engineering Science Lab + 1 Engineering Science / Professional Core (Interdisciplinary) Lab + 10 Professional Core Lab + 2 Professional Core Virtual Lab + 2 Skill Oriented Course + 3 Skill Advanced Course / Soft Skill Course + Summer Internship + Comprehensive Viva Voce + Induction Training (MC) + Constitution of India (MC) + Environmental Science(MC) + Social Values and Professional Ethics(MC) + NCC/NSS (MC)	160

COURSE WISE BREAK-UP FOR REGULAR PROGRAM:

Total Theory Courses - 35 (5 Basic Science + 2 Humanities and Social Sciences + 5 Engineering Science + 13 Professional Core + 1 Professional Core(Interdisciplinary) + 5 Professional Electives + 4 Open Electives / Job Oriented Electives)	35 @ 3credits each	105
Laboratory Courses –19 (2 Basic Science Lab + 1 Humanities and Social Sceines Lab + 3 Engineering Science Lab + 1 Engineering Science / Professional Core(Interdisciplinary) Lab + 10 Professional Core Lab + 2 Professional Core Virtual Lab)	19 @ 1.5 credits each	28.5
Summer Internship	1 @ 1.5 credit	1.5
Comprehensive Viva Voce	1 @ 1 credit	01
Skill Oriented Courses / Certification Courses - 2	2 @ 2credits each	04
Skill Advanced Courses / Soft Skill Courses / Certification Courses - 3	3 @ 2 credit	06
Project Work, Seminar and Full Semester Internship in Industry (6 Months)	1 @ 14 credits	14
Mandatory Course	5 @ 0 credits	0
Total Credits		**160**

SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. | www.svpcet.org

(20BSBH01)MATHEMATICS - I

(Common to all branches)

I B.Tech. I Sem

L	T	P	C
2	1	0	3

Course Objectives:

The course should enable the students to

- Learn the concept of a rank of the matrix and applying this concept to know the consistency and Solving the system of linear equations.
- Identify special properties of matrix and use this information to facilitate the calculation of matrix characteristics
- Find maxima and minima of function of two and three variables.
- Learn the Concept of multiple integrals and applications
- Expand the various functions as Fourier series

UNIT-I: Matrices

Matrices: Types of Matrices- Rank of a matrix by Echelon form and Normal form- System of linear equations: Gauss elimination method- Gauss Seidel Method- Consistency of system of linear equations (Rank method).

UNIT-II: Eigen values and Eigen vectors

Eigen values and Eigen vectors and their properties- Cayley-Hamilton Theorem (without proof)- finding inverse by Cayley-Hamilton Theorem- Diagonalization of a matrix- calculation of powers of matrix - Quadratic forms: Reduction of Quadratic form to canonical form and their nature .

UNIT-III: Differential Calculus and its applications

Rolle's theorem- Lagrange's Mean value theorem- simple examples of Taylor's and Maclaurin's series –Functions of several variables- Jacobian–maxima and minima functions of two variables - Lagrange's method of multipliers with three variables.

UNIT-IV: Multiple integrals

Double integrals - Cartesian & Polar form, Change of variables, Change of order of integration, Triple integrals-Change of variables. Applications: Areas (by double integrals) and Volumes (by double and triple integrals).

UNIT-V: Fourier Series

Fourier Series: Determination of Fourier coefficients – Fourier series – Even and odd functions – Fourier series in an arbitrary interval – Even and odd periodic continuation – Half-range Fourier sine and cosine expansions.

Course Outcomes:

On successful completion of the course, students will be able to		**POs related to COs**
CO1	Write the matrix representation of a set of linear equations and to analyses the solution of the System of equations	PO1,PO2,PO3
CO2	Develop the use of matrix algebra techniques that is needed by engineers for practical applications	PO1,PO2
CO3	Utilize mean value theorems to real life problems	PO1,PO2
CO4	Acquire the knowledge of multiple integrals in various coordinate systems.	PO1,PO2
CO5	Gain knowledge to tackle engineering problems using the concepts of fourier series	PO1,PO2,PO3

TEXTBOOKS:

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

REFERENCES:

1. A text book of Engineering Mathematics by N.P.Bali and Manish Goyal, Laxmi Publications, Reprint, 2008.
2. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
3. Engineering mathematics, volume-I&II, E.Rukmangadachari & E.Keshava Reddy Pearson Publishers.
4. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	--	-	-	-	-
CO2	3	3	-	-	-	-	-	-	--	-	-	-
CO3	3	3	-	-	-	-	-	-	--	-	-	-
CO4	3	3	-	-	-	-	-	-	--	-	-	-
CO5	3	3	3	-	-	-	-	-	--	-	-	-
Average	**3**	**3**	**3**	-	-	-	-	-	--	-	-	-

(20BSBH03)APPLIED PHYSICS

(Common to EEE,ECE and CSE)

L	T	P	C
3	0	0	3

Course Objectives

- To make a bridge between the physics in school and engineering courses.
- To identify the importance of the optical phenomenon i.e. interference, diffraction and polarization related to its Engineering applications
- To understand the mechanisms of emission of light, the use of lasers as light sources for low and high energy applications, study of propagation of light wave 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 micro devices.
- To enlighten the concepts of Quantum Mechanics and to provide fundamentals of de'Broglie waves, quantum mechanical wave equation and its applications, the importance of free electron theory and band theory of solids.
- Evolution of band theory to distinguish materials, basic concepts and transport phenomenon of charge carriers in semiconductors. To give an impetus on the subtle mechanism of superconductors using the concept of BCS theory and their fascinating applications.

Unit-I:
Wave Optics

Interference- Principle of superposition – Interference of light – Conditions for sustained interference--Interference in thin films (Reflection Geometry) –Newton's Rings – Determination of wavelength and refractive index.
Diffraction- Introduction – Fresnel and Fraunhofer diffraction – Fraunhofer diffraction due to single slit, double slit and N-slits (qualitative) – Grating spectrum.
Polarization- Introduction – Types of polarization – Polarization by reflection, refraction And double refraction - Nicol's Prism - Half wave and Quarter wave plates with applications.

Unit-II:
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 –Semiconductor 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 – Bloch diagram of optical fibre communication system– Propagation Losses (qualitative) – Applications.

Unit-III:

Dielectric and Magnetic Materials

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 -- Domain theory of ferromagnetism– Hysteresis – Soft and Hard magnetic materials.

Unit IV:

Quantum Mechanics and Band theory of Solids

Quantum Mechanics- Dual nature of matter – Schrodinger's time independent wave equation – Significance of wave function – Particle in a one-dimensional infinite potential well.

Band theory of Solids- Classical free electron theory (Merits and demerits only) – Quantum free electron theory (Merits and demerits only) – Fermi- Dirac distribution – Density of states – Fermi energy.

Bloch's Theorem (Qualitative) – Kronig-Penney model (Qualitative) – E vs K diagram – Classification of crystalline solids –Concept of hole.

Unit – V:
Semiconductors and Superconductors

Semiconductors- Introduction – Intrinsic semiconductors – Density of charge carriers(Qualitative) – Electrical conductivity – Fermi level – Extrinsic semiconductors – Density of charge carriers(Qualitative) – Dependence of Fermi energy on carrier concentration and temperature – Drift and diffusion currents – Einstein's equation – Direct and indirect band gap semiconductors – Hall effect– Applications of 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.

Course Outcomes

On successful completion of the course, students will be able to		POs related to COs
CO1	Study the different realms of physics and their applications in both scientific and technological systems through physical optics.	PO1,PO2
CO2	Identify the wave properties of light and the interaction of energy with the matter	PO1,PO2
CO3	Asses the electromagnetic wave propagation and its power in different media	PO1,PO2,PO3
CO4	Understands the response of dielectric and magnetic materials to the applied electric and magnetic fields.	PO1,PO2
CO5	Study the quantum mechanical picture of subatomic world along with the discrepancies between the classical estimates and laboratory observations of electron transportation phenomena by free electron theory and band theory.	PO1

Text books:

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.

Reference Books:

1. Engineering Physics – Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018
2. Engineering Physics – K. Thyagarajan, McGraw Hill Publishers
3. Engineering Physics - Sanjay D. Jain, D. Sahasrambudhe and Girish, University Press
4. Semiconductor physics and devices- Basic principle – Donald A, Neamen, Mc Graw Hill

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	2	3		-	-	-		-	-	-	-	-
CO3	2	2	2	--	--	--	-	-	--	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	--	-	-	-	-
Average	**2.6**	**2.25**	**2**	-	-	-	-		-	-	-	-

(20ES0501) PROBLEM SOLVING USING C
(Common to all branches)

I B.Tech. I Sem

L	T	P	C
2	1	0	3

Course Objectives:

- To Understand the Hardware of the computer and the General form of a C program.
- To Understand the Decision Making and Loop statements of C Language.
- To Understand the Arrays and String concept of C Language.
- To understand the concept of Functions and Pointers in C Language.
- To Understand about Structures, Unions and Files in C Language.

UNIT I - INTRODUCTION TO C PROGRAMMING

Basics of C Programming: Introduction, Computer Languages, Algorithm, Flowchart, Structure of a C program, Concept of a variable, Data types in C, Program statement, Declaration, Storing the data in memory, Tokens, Operators and expressions, Type conversions

Input-Output Library Functions: Unformatted I-O Functions, Single Character Input-Output, String Input-Output, Formatted I-O Functions, printf() Width Specifier, scanf() Width Specifier

UNIT-II- CONTROL STATEMENTS

Conditional Control Statements, if. if-else ,nested if-else .else-if ladder ,Multiple Branching Control Statement ,switch-case ,Loop Control Statements, while ,do-while, for ,Nested Loops, Jump Control statements ,break ,continue ,goto,exit ,return

Function: Function and its uses, Function Prototype, Defining a function, Calling a function, Returnstatement, Types of functions,Recursion,Nested functions, main() function, LibraryFunction, Local and global variables

UNIT-III ARRAYS

Arrays- Definition, One-Dimensional Arrays- Declaration, Initialization, “for” loop for Sequential access, Example Programs. Two-Dimensional Arrays: Declaration, Initialization, Example Programs.

Strings- Introduction, Declaration and Initialization of String Variables, Reading Strings from Terminal, Writing Strings to screen, Arithmetic Operators on Characters, Putting Strings Together, Comparison of Two Strings, String Handling Functions, Table of Strings.

UNIT-IV ADVANCED FEATURES IN C :

Pointers, relationship between arrays and pointers Argument passing using pointers, Array of pointers. Passing arrays as arguments. Strings and C string library.

Structure and Union. Defining C structures, giving values to members, Array of structure, Nestedstructure, passing strings as arguments

UNIT-VFile Management in C-
Introduction, Types of Files, Defining and Opening a File, Closing a File, Input/output Operation on Files, Error handling during I/O Operations, Random Access to Files, Command Line Arguments

Course Outcomes:

On successful completion of the course, students will be able to		**POs related to COs**
CO1	Able to describe the Hardware components of a computer.	PO1,PO2
CO2	Able to implement the 'if...else' statements and 'for', 'while', 'do…while' loop statements	PO1,PO2,PO3
CO3	Able to write programs using Arrays and Strings concept.	PO1,PO2
CO4	Able to implement Function and Pointer concepts on various applications.	PO1,PO2,PO4
CO5	Able implement File concepts of C Language.	PO1,PO2

Text Books

1. Programming In "C" and Data Structures- By Jeri. R. Hanly, Elliot. B. Koffman, Ashok Kamthane, A. AnandaRao, 5th Edition, Pearson Publication. (Units I and II).
2. Programming In "C" and Data Structures- By E. Balagurusamy, McGraw Hill Publication

CO-PO Mapping

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	-	-	--	-	-	-	-	-	-
CO2	3	2	3	-	-	--	-	-	-	-	-	-
CO3	3	3	-	-	-	--	-	-	-	-	-	-
CO4	3	3	-	3	-	--	-	-	-	-	-	-
CO5	2	3	-	-	-	--	-	-	-	-	-	-
Average	**2.8**	**2.8**	**3**	**3**	**-**	**--**	**-**	**-**	**-**	**-**	**-**	**-**

SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. | www.svpcet.org

(20HSBH01)Technical English

(Common to CE,EEE,MECH&ECE)

L	T	P	C
3	0	0	3

Course Objectives:

- To enable the students to communicate in English for academic and social purpose
- Toenablethestudentstoacquirestructuresandwrittenexpressionsrequired for the profession
- To enhance the study skills of the students with emphasison LSRW skills
- Toencourageinvestigatingquestionsofthehumanitiesthrowrhetoricalstudy
- To develop and practice and evaluative reading

UNIT– I

Chapterentitled"MEDIAMATTERS"fromMindscapesEnglishforTechnologistsandEngineers

L-Techniques– Importance of Phonetics and Correct Pronunciation
S-Meet &Greet and Leave taking, Introducing Oneself and others (Formal and Informal situations)
R-Reading strategies-Skimming and Scanning W
- Writing strategies – Sentence structures
G- PartsofSpeech–Noun-number, Pronoun- Personal Pronoun–Verb–analysis V -
Affixes – Prefix and Suffix – Root words, derivatives

UNIT– II

Chapterentitled"LESSONSFROMTHEPAST"fromMindscapesEnglishforTechnologists and Engineers

L-Listeningto details:TypesofListening1.Discriminative listening2.Comprehension listening 3. Critical listening 4. Appreciative listening
S-Requesting,MakingPoliteConversationsandRolePlay R -
Note Taking and Note Making Strategies
W-ParagraphWritingand GoodqualitiesofParagraph

G-Tenses–PresentTense, PastTenseandFutureTense
V-Homonyms,Homophones, Homographs,SynonymsandAntonyms

UNIT– III

Chapterentitled"TRAVELANDTOURISM"fromMindscapesEnglishforTechnologistsand Engineers

L-Listeningto SpeechesofGreat leadersandScientists S -
Accepting Invitations, Fixing a Time and AdvisingR -
Reading Tables, and Charts
W-Conversation, RolePlayandautobiography
G-TypesofSentences(Simple,ComplexandCompound) V -
Word formations and One –Word Substitutes

UNIT– IV

Chapterentitled"THELOSTLEAF" fromAmerican storiesby O. Henry

L- ListeningDialoguesandNews
S-ExpressingIdeas,OpinionsandTelephoneSkills R -
Reading Short Stories
W-BiographyandReportingWriting G
-Conditional Clauses and Voices V -
Fixed Expressions and Idioms

UNIT– V

Chapterentitled "SUNITAWILLIAMS"AStarinSpace:PuffinLivesKindleEdition by Aravinda Anatharaman

L-TypesofListeningSpeeches:Informative,Demonstrative,Persuasive,Entertaining
S-MakingPresentations(MimeandGuess,Monoaction,AutobiographyandBiography) R -
Reading for Entertainment (Humorous short skits)
W–Resume,CVandCoverletter
G-DirectSpeech&IndirectSpeech V -
Phrasal Verbs and Collocations

Course Outcomes:

Onsuccessfulcompletionofthecourse, studentswillbeableto		**POsrelatedto COs**
CO1	Studentcanresponding toavarietyofsituationsandcontexts callingforpurposefulshiftsinthevoice,tonelevelofformality, design, medium andstructure	PO1,PO10
CO2	Becomeeffectiveintheuseofdifferentmodesofwritten communicationinprofessionalenvironment	PO1,PO10,PO12
CO3	WelltrainedinLSRWskillsanddevelopcommunicate competence	PO1,PO9
CO4	Usekeyrhetoricalconceptsthroughanalyzing andcomposinga varietyoftext	PO1,PO12
CO5	Developcompetencetoapplydifferentreadingmethodsto evaluatea massofdataonthe net andto gleanthenecessary information	PO1,PO6

TextBook:

1. MindscapesEnglishforTechnologistsandEngineersPublishedbyOrientBlackSwan
2. Americanstories byO. Henry
3. AStar inSpace:PuffinLivesKindleEditionbyAravindaAnatharaman

References:

1. A.TextbookofEnglishPhoneticsfor IndianStudentsbyT.Balasubramanian,2012
2. CommunicationSkills,SanjayKumar&PushpalathaOxfordUniversityPress
3. EveryDayDialoguesinEnglish – RobertJ.Dixson,PrenticeHallofIndia
4. RaymondMurphy'sEnglishGrammarwithCD,Murphy,CambridgeUniversityPress,2012

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	2	-	2
CO3	3	-	-	-	-	-	-	-	3	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	3
CO5	3	-	-	-	-	3	-	-	-	-	-	-
Average	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**3**	**2.5**	**-**	**2.5**

(20ES0201) ELCTRICAL CIRCUITS
(COMMON TO ECE& EEE)

L	T	P	C
3	0	0	3

I B.Tech . I Sem Syllabus

Course Objectives:

To make the student learn about

- Basic characteristics of R,L,C parameters
- Network reduction techniques, star to delta and delta to star transformations
- The concepts of real power, reactive power, complex power, phase angle and phase difference
- Network theorems and their applications
- How to compute two port network parameters
- Series and parallel resonances, bandwidth

UNIT- I INTRODUCTION TO ELECTRICAL CIRCUITS

Electrical Circuits: Circuit Concept, R, L and C Parameters - Independent and Dependent Voltage and Current Source, Voltage - Current Relationship for Passive Elements- Kirchhoff's Laws, Network Reduction Techniques: Series, Parallel, Series Parallel, Star-to-Delta or Delta-to-Star Transformation.

UNIT- II 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 Combinations) with Sinusoidal Excitation- Phasor diagrams - Concept of Power Factor- Concept of Reactance, Impedance, Susceptance and Admittance-Apparent Power, Active and Reactive Power, Examples.

UNIT- III NETWORK THEOREMS

Mesh and Nodal analysis. Thevenin's, Norton's, Maximum Power Transfer, Superposition, Reciprocity and Compensation Theorems for D.C And Sinusoidal Excitations.

TWO PORT NETWORKS

Two Port Network Parameters: Impedance, Admittance, Transmission and Hybrid Parameters and their Relations.

UNIT- IV RESONANCE

Introduction, Definition of 'quality factor **Q**' of inductor and capacitor, Series resonance, Bandwidth of the series resonant circuits, Parallel resonance (or anti-resonance), Conditions for maximum impedance, Currents in parallel resonance, Impedance variation with frequency; universal resonance curves, Bandwidth of parallel resonant circuits, General case of parallel resonance circuit.

UNIT- V 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.

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.

Course Outcomes:

On successful completion of the course, students will be able to		POs related to COs
CO1	understanding of Given a network, find the equival impedance by using network reduction techniques	PO1,PO2,PO3,PO5,PO9,PO10,PO12
CO2	The knowledge to about Given a circuit and the excitation, determine the real power, reactive power, power factor etc,	PO2,PO3,PO5,PO9,PO10
CO3	Determine the current through any element and voltage across any element	PO1,PO3,PO5,PO10
CO4	Apply the network theorems suitably	PO3,PO5,PO10,PO12
CO5	Analysis for D.C Excitation - Initial Conditions in network.	PO2,PO3PO5,PO10,PO12

TEXT BOOKS:

1. Electrical Circuit Theory and Technology 4th Edition, John Bird, Rovtledge/T&F, 2011.
2. Network Analysis 3rd Edition, M.E Van Valkenberg, PHI.

REFERENCES:

1. Circuit Theory (Analysis & Synthesis) 6th Edition, A. Chakrabarti, Dhanpat Rai & Sons, 2008.
2. Electric Circuits by N.Sreenivasulu, REEM Publications
3. Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, Mc Graw Hill Company, 6th edition.
4. Circuits & Networks by A. Sudhakar and Shyammohan S Palli, Tata McGraw- Hill

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2		2				1	1		2
CO2		2	2		2				2	2		
CO3	2		3		2					2		
CO4			2		1					3		2
CO5		1	2		2					2		2
Average	**2.5**	**1.7**	**2.2**		**1.8**				**1.5**	**2.2**		**2**

(20BSBH04)APPLIED PHYSICS LAB

(Common to EEE,ECE and CSE)

L	T	P	C
0	0	3	1.5

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 and Hall Effect in a semiconductor.
- Illustrates the magnetic and dielectric materials applications.
- Apply the principles of semiconductors in various electronic devices.

Note: In the following list, out of 15 experiments, any 10 experiments (minimum 8) must be performed in a semester

List of Applied Physics 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 dispersive power of prism.
5. Determination of wavelength of LASER light using diffraction grating.
6. Determination of particle size using LASER.
7. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle
8. Determination of dielectric constant by charging and discharging method.
9. Magnetic field along the axis of a circular coil carrying current –Stewart Gee's method.
10. Measurement of magnetic susceptibility by Gouy's method
11. Study the variation of B versus H by magnetizing the magnetic material (B-H curve)
12. To determine the resistivity of semiconductor by Four probe method
13. To determine the energy gap of a semiconductor
14. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect.
15. Measurement of resistance with varying temperature.

References

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

Course Outcomes:

CO1	Recognize the important radius of curvature - Newton's Rings (PO1, PO2) . (PO1, PO2,PO3)
CO2	Acquired the practical application knowledge of optical fiber, resonance – series and parallel LCR circuits (PO1, PO2, PO3)
CO3	Analyze the practical applications of power of prism and wavelength of LASER light using diffraction grating in various engineering feels. (PO1, PO2)
CO4	Understand of practical laser by the study of their relative parameters. (PO1, PO2)
CO5	Recognize power of prism – Spectrometer, material of B-H curve in various engineering tools (PO1,PO2,PO4)
CO6	Follow the ethical principles in implementing the experiments (PO8)
CO7	Do experiments effectively as an individual and as a team member in a group. (PO9)
CO8	Communicate verbally and in written form, the understanding about the experiments. (PO10)
CO9	Continue updating their skill related to optical fiber, B-H curve, laser and LCR circuits in implementing experiments in future. (PO12)

CO-PO Mapping

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2												
CO2	2	3	3											
CO3	2	3												
CO4	3	2												
CO5	3	2		3										
CO6								3						
CO7									2					
CO8										3				
CO9												3		
Average	**2.6**	**2.4**	**3**	**3**	-	-	-	3	2	**3**	-	**3**	**2**	**3**

Problem Solving Through C Autonomous Syllabus (R20)

1. **Mathematical Problems** **[10]**
    a. **Calculate the bill for your grocery shopping**
    b. **Find $(a+b)^2$**
    c. **Calculate the distance travelled by the object.**
    d. **Convert the temperature in centigrade to Fahrenheit**
    e. **Calculate the simple and compound interest calculation**
    f. **Find area of triangle**
    g. **Print '*'**
2. **English vocabulary (String Operations)** **[07]**
    a. **Find synonyms**
    b. **Find Antonyms**
    c. **Search word**
    d. **Get abbreviations**
    e. **Find string length, palindrome. Find vowels etc.,**
3. **Physics Problems**

    Projectile Motion Example Problem:

    A cannon is fired with muzzle velocity of 150 m/s at an angle of elevation = 45°. Gravity = 9.8 m/s^2.

    a) What is the maximum height the projectile reaches?

    b) What is the total time aloft?

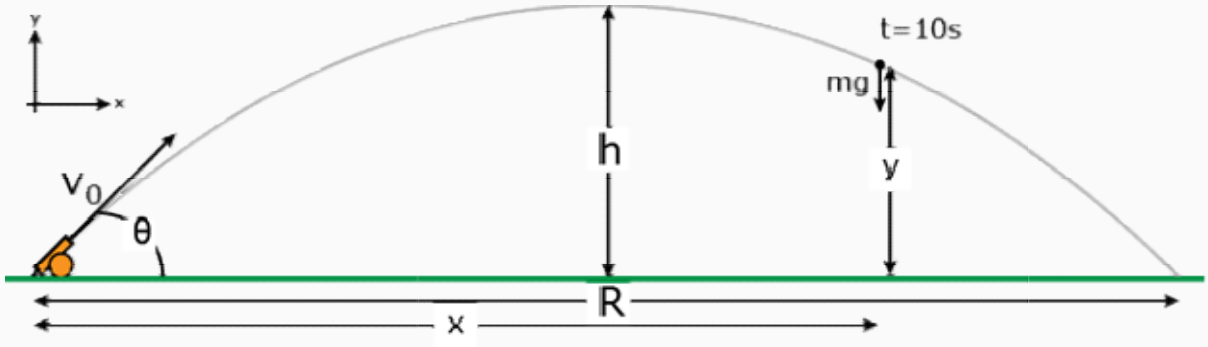
    c) How far away did the projectile land? (Range)

    d) Where is the projectile at 10 seconds after firing?
4. **Chemistry Problems**
    a. Boyle's Law
    b. Acid-Base Titration Problem
    c. Avogadro's Law Equation
5. **'C' Graphics** **[07]**
    a. **Print Basic Shapes.**
    b. **Text fonts, sizes, direction.**
    c. **Draw smiley face.**
    d. **Design user interface for login.**
    e. **Print Bar Chart / Pie Chart.**
    f. **Print a shape in incremental way.**
6. **File Operations** **[05]**
    a. **Create a file.**
    b. **Read a File.**
    c. **Copy a File.**
    d. **Merge two files.**
    e. **Create a database**
7. **Applications** **[01]**
    a. **Students Academic Register.**
    b. **Electricity Bill Generation.**
    c. **Employee Pay slips.**
    d. **Print date, system IP address, Shutdown computer.**

3. Support document for physics problems

Throwing or shooting a projectile follows a parabolic course. If you know the initial velocity and angle of elevation of the projectile, you can find its time aloft, maximum height or range. You can also its altitude and distance travelled if given a time. This example problem shows how to do all of these.

Projectile Motion Example Problem:
A cannon is fired with muzzle velocity of 150 m/s at an angle of elevation = 45°. Gravity = 9.8 m/s^2.
a) What is the maximum height the projectile reaches?
b) What is the total time aloft?
c) How far away did the projectile land? (Range)
d) Where is the projectile at 10 seconds after firing?



Let's set up what we know. First, let's define our variables.

V_0 = initial velocity = muzzle velocity = 150 m/s
v_x = horizontal velocity component
v_y = vertical velocity component
θ = angle of elevation = 45°
h = maximum height
R = range
x = horizontal position at t=10 s
y = vertical position at t=10 s
m = mass of projectile
g = acceleration due to gravity = 9.8 m/s^2

Part a) Find h.

The formulas we will be using are:

$d = v_0t + ½at^2$

and

$v_f - v_0 = at$

In order to find the distance h, we need to know two things: the velocity at h and the amount of time it takes to get there. The first is easy. The vertical component of the velocity is equal to zero at point h. This is the point where the upward motion is stopped and the projectile begins to fall back to Earth.

The initial vertical velocity is
$v_{0y} = v_0 \cdot \sin\theta$
$v_{0y} = 150 \text{ m/s} \cdot \sin(45°)$
$v_{0y} = 106.1 \text{ m/s}$

Now we know the beginning and final velocity. The next thing we need is the acceleration.

The only force acting on the projectile is the force of gravity. Gravity has a magnitude of g and a direction in the negative y direction.

$F = ma = -mg$

solve for a

$a = -g$

Now we have enough information to find the time. We know the initial vertical velocity (V_{0y}) and the final vertical velocity at h ($v_{hy} = 0$)

$v_{hy} - v_{0y} = at$
$0 - v_{0y} = -9.8 \text{ m/s}^2 \cdot t$
$0 - 106.1 \text{ m/s} = -9.8 \text{ m/s}^2 \cdot t$

Solve for t

$$t = \frac{-106.1 \text{ m/s}}{-9.8 \text{ m/s}^2}$$

t = 10.8 s

Now solve the first equation for h

$h = v_{0y}t + \frac{1}{2}at^2$
$h = (106.1 \text{ m/s})(10.8 \text{ s}) + \frac{1}{2}(-9.8 \text{ m/s}^2)(10.8 \text{ s})^2$
$h = 1145.9 \text{ m} – 571.5 \text{ m}$
$h = 574.4 \text{ m}$

The highest height the projectile reaches is 574.4 meters.

Part b: Find total time aloft.

We've already done most of the work to get this part of the question if you stop to think. The projectile's trip can be broken into two parts: going up and coming down.

$t_{total} = t_{up} + t_{down}$

The same acceleration force acts on the projectile in both directions. The time down takes the same amount of time it took to go up.

$t_{up} = t_{down}$

or

$t_{total} = 2\ t_{up}$

we found t_{up} in Part a of the problem: 10.8 seconds

$t_{total} = 2 \text{ (10.8 s)}$
$t_{total} = 21.6 \text{ s}$

The total time aloft for the projectile is 21.6 seconds.

Part c: Find range R

To find the range, we need to know the initial velocity in the x direction.

$v_{0x} = v_0 \cos\theta$
$v_{0x} = 150 \text{ m/s} \cdot \cos(45)$
$v_{0x} = 106.1 \text{ m/s}$

To find the range R, use the equation:

$R = v_{0x}t + \frac{1}{2}at^2$

There is no force acting along the x-axis. This means the acceleration in the x-direction is zero. The equation of motion is reduced to:

$R = v_{0x}t + \frac{1}{2}(0)t^2$
$R = v_{0x}t$

The range is the point where the projectile strikes the ground which happens at the time we found in Part b of the problem.

$R = 106.1 \text{ m/s} \cdot 21.6\text{s}$
$R = 2291.8 \text{ m}$

The projectile landed 2291.8 meters from the canon.

Part d: Find the position at t = 10 seconds.

The position has two components: horizontal and vertical position. The horizontal position, x, is far downrange the projectile is after firing and the vertical component is the current altitude, y, of the projectile.

To find these positions, we will use the same equation:

$d = v_0t + \frac{1}{2}at^2$

First, let's do the horizontal position. There is no acceleration in the horizontal direction so the second half of the equation is zero, just like in Part c.

$x = v_{0x}t$

We are given t = 10 seconds. V_{0x} was calculated in Part c of the problem.

$x = 106.1 \text{ m/s} \cdot 10 \text{ s}$
$x = 1061 \text{ m}$

Now do the same thing for the vertical position.

$y = v_{0y}t + \frac{1}{2}at^2$

We saw in Part b that $v_{0y} = 109.6$ m/s and $a = -g = -9.8$ m/s^2. At t = 10 s:

$y = 106.1 \text{ m/s} \cdot 10 \text{ s} + \frac{1}{2}(-9.8 \text{ m/s}^2)(10 \text{ s})^2$
$y = 1061 – 490 \text{ m}$
$y = 571 \text{ m}$

At t=10 seconds, the projectile is at (1061 m, 571 m) or 1061 m downrange and at an altitude of 571 meters.

If you need to know the velocity of the projectile at a specific time, you can use the formula

$v – v_0 = at$

and solve for v. Just remember velocity is a vector and will have both x and y components.

This specific example can be easily adapted for any initial velocity and any angle of elevation. If the cannon is fired on another planet with a different force of gravity, just change the value of g accordingly.

4 Support document for Chemistry problems

1. An acid-base titration is a neutralization reaction performed in the lab to determine an unknown concentration of acid or base. The moles of acid will equal the moles of the base at the equivalence point. So if you know one value, you automatically know the other. Here's how to perform the calculation to find your unknown:

Acid-Base Titration Problem

If you're titrating hydrochloric acid with sodium hydroxide, the equation is:

$HCl + NaOH \rightarrow NaCl + H_2O$

You can see from the equation there is a 1:1 molar ratio between HCl and NaOH. If you know that titrating 50.00 ml of an HCl solution requires 25.00 ml of 1.00 M NaOH, you can calculate the concentration of hydrochloric acid, HCl. Based on the molar ratio between HCl and NaOH, you know that at the equivalence point:

moles HCl = moles NaOH

Acid-Base Titration Solution

Molarity (M) is moles per liter of solution, so you can rewrite the equation to account for molarity and volume:

$M_{HCl} \times volume_{HCl} = M_{NaOH} \times volume_{NaOH}$

Rearrange the equation to isolate the unknown value. In this case, you are looking for the concentration of hydrochloric acid (its molarity):

$M_{HCl} = M_{NaOH} \times volume_{NaOH} / volume_{HCl}$

Now, simply plug in the known values to solve for the unknown:

$M_{HCl} = 25.00 \text{ ml} \times 1.00 \text{ M} / 50.00 \text{ ml}$

$M_{HCl} = 0.50 \text{ M HCl}$

2. Avogadro's gas law states the volume of a gas is proportional to the number of moles of gas present when the temperature and pressure are held constant. This example problem demonstrates how to use Avogadro's law to determine the volume of a gas when more gas is added to the system.

Avogadro's Law Equation

Before you can solve any problem regarding Avogadro's gas law, it's important to review the equation for this law. There are a few ways to write this gas law, which is a mathematical relation. It may be stated:

$k = V/n$

Here, k is a proportionality constant, V is the volume of a gas, and n is the number of moles of a gas. Avogadro's law also means the ideal gas constant is the same value for all gases, so:

$\text{constant} = p_1V_1/T_1n_1 = P_2V_2/T_2n_2$
$V_1/n_1 = V_2/n_2$
$V_1n_2 = V_2n_1$

where p is pressure of a gas, V is volume, T is temperature, and n is number of moles.

Avogadro's Law Problem

A 6.0 L sample at 25°C and 2.00 atm of pressure contains 0.5 mole of a gas. If an additional 0.25 mole of gas at the same pressure and temperature are added, what is the final total volume of the gas?

Solution

First, express Avogadro's law by its formula:

$V_i/n_i = V_f/n_f$
where
V_i = initial volume
n_i = initial number of moles
V_f = final volume
n_f = final number of moles

For this example, V_i = 6.0 L and n_i = 0.5 mole. When 0.25 mole is added:

$n_f = n_i + 0.25$ mole
$n_f = 0.5$ mole $= 0.25$ mole
$n_f = 0.75$ mole

The only variable remaining is the final volume.

$V_i/n_i = V_f/n_f$

Solve for V_f

$V_f = V_i n_f/n_i$
$V_f = (6.0\text{ L} \times 0.75\text{ mole})/0.5\text{ mole}$
$V_f = 4.5\text{ L}/0.5$ $V_f = 9$ L

Check to see if the answer makes sense. You would expect the volume to increase if more gas is added. Is the final volume greater than the initial volume? Yes. Doing this check is useful because it is easy to put the initial number of moles in the numerator and the final number of moles in the denominator. If this had happened, the final volume answer would have been smaller than the initial volume.

Thus, the final volume of the gas is 9.0

Notes Regarding Avogadro's Law

- Unlike Avogadro's number, Avogadro's law was actually proposed by Amedeo Avogadro. In 1811, he hypothesized two samples of an ideal gas with the same volume and at the same pressure and temperature contained the same number of molecules.
- Avogadro's law is also called Avogadro's principle or Avogadro's hypothesis.
- Like the other ideal gas laws, Avogadro's law only approximates the behavior of real gases. Under conditions of high temperature or pressure, the law is inaccurate. The relation works best for gases held at low pressure and ordinary temperatures. Also, smaller gas particles—helium, hydrogen, and nitrogen—yield better results than larger molecules, which are more likely to interact with each other.
- Another mathematical relation used to express Avogadro's law is:

$V/n = k$

Here, V is the volume, n is the number of moles of the gas, and k is the proportionality constant. It's important to note this means the ideal gas constant is *the same* for all gases.

3. If you trap a sample of air and measure its volume at different pressures (constant temperature), then you can determine a relation between volume and pressure. If you do this experiment, you will find that as the pressure of a gas sample increases, its volume decreases. In other words, the volume of a gas sample at constant temperature is inversely proportional to its pressure. The product of the pressure multiplied by the volume is a constant:

$PV = k$ or $V = k/P$ or $P = k/V$

where P is pressure, V is volume, k is a constant, and the temperature and quantity of gas are held constant. This relationship is called **Boyle's Law**, after Robert Boyle, who discovered it in 1660.

Key Takeaways: Boyle's Law Chemistry Problems

- Simply put, Boyle's states that for a gas at constant temperature, pressure multiplied by volume is a constant value. The equation for this is PV = k, where k is a constant.
- At a constant temperature, if you increase the pressure of a gas, its volume decreases. If you increase its volume, the pressure decreases.
- The volume of a gas is inversely proportional to its pressure.
- Boyle's law is a form of the Ideal Gas Law. At normal temperatures and pressures, it works well for real gases. However, at high temperature or pressure, it is not a valid approximation.

Worked Example Problem

The sections on the General Properties of Gases and Ideal Gas Law Problems may also be helpful when attempting to work Boyle's Law problems.

Problem

A sample of helium gas at 25°C is compressed from 200 cm^3 to 0.240 cm^3. Its pressure is now 3.00 cm Hg. What was the original pressure of the helium?

Solution

It's always a good idea to write down the values of all known variables, indicating whether the values are for initial or final states. Boyle's Law problems are essentially special cases of the Ideal Gas Law:

Initial: P_1 = ?; V_1 = 200 cm^3; n_1 = n; T_1 = T

Final: P_2 = 3.00 cm Hg; V_2 = 0.240 cm^3; n_2 = n; T_2 = T

$P_1V_1 = nRT$ (Ideal Gas Law)

$P_2V_2 = nRT$

so, $P_1V_1 = P_2V_2$

$P_1 = P_2V_2/V_1$

P_1 = 3.00 cm Hg x 0.240 cm^3/200 cm^3

$P_1 = 3.60 \times 10^{-3}$ cm Hg

Did you notice that the units for the pressure are in cm Hg? You may wish to convert this to a more common unit, such as millimeters of mercury, atmospheres, or pascals.

3.60×10^{-3} Hg x 10mm/1 cm = 3.60×10^{-2} mm Hg

3.60×10^{-3} Hg x 1 atm/76.0 cm Hg = 4.74×10^{-5} atm

SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. | www.svpcet.org

(20BSBH02) MATHEMATICS-II

(Common to all branches)

I B.Tech II Sem

L	T	P	C
2	1	0	3

Course Objectives:

The course should enable the students to

- Solve the Methods of differential equations of first and higher order.
- Learn the basic properties of vector valued functions and their applications to line Surface and volume integrals.
- Know the concept of Laplace transforms and apply to solve the ordinary differential equations

UNIT – 1: First Order O.D.E

Introduction to Ordinary Differential equations- Exact - linear and Bernoulli's equations - Applications to Newton's law of cooling- law of natural growth and decay-Orthogonal trajectories.

UNIT –2: Ordinary Differential Equations of higher order

Homogeneous and Non homogeneous linear differential equations of second and higher order with constant coefficients with RHS terms of type e^{ax} - sin ax- cos ax- polynomials in x- e^{ax} v(x) - xv(x).

UNIT –3: Vector Calculus

Introduction-Vector differentiations-Vector differential operator- Gradient – Divergence-Curl and their properties - Vector integration - Line integral-Potential function – Area - Surface and volume integrals- Vector integrals theorems: Green's theorem - Stoke's and Gauss's Divergence theorem (without proof) – problems.

UNIT– 4 Laplace Transform-I

Laplace transform of standard functions– First shifting Theorem - Second shifting theorem- Transforms of derivatives and integrals – Unit step function –Dirac's delta function- Laplace transform of periodic functions.

UNIT–5 Laplace Transform-II

Convolution theorem- Differentiation and integration of transform – Inverse laplace transform – Application of Laplace transforms to ordinary differential equations of first and second order.

Course Outcomes:

On successful completion of the course, students will be able to		**Pos related to Cos**
CO1	Identify whether the given differential equation of first order is exact or not.	PO1,PO2,PO3,PO4,PO5,PO12
CO2	Solve higher differential equation and apply the concept of differential equation to real world problems	PO1,PO2,PO3,PO4,PO5,PO12
CO3	Evaluate the line, surface and volume integrals and converting them from one to another	PO1,PO2,PO3,PO4,PO5,PO12
CO4	Analyze the engineering problems using the concept of Laplace transforms	PO1,PO2,PO3,PO4,PO5,PO12
CO5	Gain knowledge to tackle engineering problems using the concepts of Inverse Laplace transforms.	PO1,PO2,PO3,PO4,PO5,PO12

Text Books:

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Engineering Mathematics Volume-I &II by T.K.V. Iyengar, S.Chand publication.

Reference Books:

1. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.
2. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
4. Engineering Mathematics, volume-I&II, E. Rukmangadachari& E.Keshava Reddy Pearson Publishers.

CO-PO Mapping

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	3							3
CO2	2	2	2	3	3							2
CO3	3	2	2	2	2							2
CO4	2	3	3	2	2							2
CO5	3	2	3	2	2							2
Average	**2.6**	**2.2**	**2.4**	**2.2**	**2.4**							**2.2**

SRI VENKATESA PERUMAL COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. | www.svpcet.org

(20BSBH07)APPLIED CHEMISTRY

(Common to EEE,ECE and CSE)

L	T	P	C
3	0	0	3

Course Objectives:

- To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
- To provide the information regarding hardness of water, effects of hard water in boilers and treatment methods to avoid bad effect on human health. To check the parameters of various water samples by experimental techniques.
- To make the properties and applications of polymers and engineering materials.
- To make apply the principle of band diagrams in application of conductors and semiconductors.
- To make students familiar with importance of electrochemical processes in nature and industry, like coating of objects with metals or metal oxides through electro deposition.

UNIT – I: WATER QULAITY AND ITS TREATMENT

INTRODUCTION: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness –Numerical problems on estimation of hardness.

CHEMICAL ANALYSIS OF WATER: Estimation of hardness of water by EDTA method, acidity, alkalinity and dissolved oxygen (BOD & COD).

BOILER TROUBLES: scales and sludges, caustic embrittlement, boiler corrosion and priming and foaming.

SOFTENING OF WATER: Internal Conditioning - Phosphate Conditioning, Calgon Conditioning; **External Treatment** - Zeolite process and Ion-exchange process, advantages and applications.

WATER FOR MUNICIPAL TREATMENT: Disinfection, Chlorination – Breakpoint Chlorination**,** Ozonization, UV Treatment – Reverse Osmosis: Desalination of Brakish water by Electrodialysis.

UNIT – II: MOLECULAR STRUCTURE & THEORIES OF BONDING:

Atomic and Molecular orbitals, Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N_2, O_2 and H_2^+ molecules. π molecular orbitals of 1,3 butadiene, CO_2 and benzene.

CRYSTAL FIELD THEORY (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries (One Specific Example for Each)

UNIT – III: ELECTRO CHEMISTRY AND APPLICATIONS

Introduction to electrochemistry, electrodes-concepts of reference electrodes (Calomel electrode, Ag/AgCl electrode and glass electrode); Electrochemical cell, Nernst equation cell potential calculation

and numerical problems, pH metry, potentiometry-potentiometric titrations (redox titration), concept of conductivity- Specific, equivalent & molar conductance and cell constant, conductivity cell, conductometric titration (acid-base titrations).

Primary cells – Zinc – air, Na-air batteries, secondary cells – Nickel-Cadmium (NiCd), and lithium ion batteries-working of the batteries including cell reactions; fuel cells: Hydrogen-Oxygen, methanol fuel cells- working of the cells and applications.

UNIT-IV: POLYMER CHEMISTRY

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, copolymerization (stereospecific polymerization) with specific examples and mechanisms of polymer formation.
Plastics – Thermoplastics and Thermosettings, Preparation, properties and applications of PVC, Teflon, Bakelite, Nylon-6,6, carbon fibres.
Elastomers – Buna-S, Buna-N preparation, properties and applications.
Conducting polymers – Polyacetylene, polyaniline, polypyrroles-mechanism of conduction and applications.

UNIT – V: MODERN ENGINEERING MATERIALS

i) Semiconductor : Materials, superconductors – basic concept, band diagrams for conductors, semiconductors and insulators, effect of doping on band structures.

ii) Supercapacitors: Introduction, basic concept – classification-applications.

iii) Nanochemistry : Introduction, classification of nanometerials, properties and application of fullerence, carbon nanotubes and grapheme nanoparticles.

Course Outcomes

On successful completion of the course, students will be able to		**POs related to COs**
CO1	The understanding the problem of water and its treatments.	PO1,PO2,PO3
CO2	The knowledge of atomic, molecular and electronic changes, band theory related to conductivity.	PO1,PO2,PO3
CO3	The required principles and concepts of electrochemistry	PO1,PO2,PO3,PO7
CO4	The knowledge of polymers, elastomers & plastics.	PO1,PO2
CO5	The required skills to get clear concepts on nano technology, semi conductors, carbon nano tubes.	PO1,PO2

SUGGESTED TEXT BOOKS:

1. Engineering Chemistry by P.C.Jain & M.Jain; Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
2. Arun Bahl, B.S. Bahl and G.D. Tuli, Essentials of Physical chemistry, S. Chand Publication, New Delhi 2012.
3. Organic Chemistry: Structure and Function by K.P.C. Volhardt and N.E.Schore, 5th Edition.
4. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane

REFERENCES

1. G.V. Subba Reddy, K.N. Jayaveera and C. Ramachandraiah, Engineering Chemistry, Mc Graw Hill, 2020.

2. J.D. Lee, Concise Inorganic Chemistry, 5/e, Oxford University Press, 2008.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	3	2	3	-	-	-		-	-	-	-	-
CO3	3	3	2	--	--	--	3	-	--	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	--	-	-	-	-
Average	**3**	**2.2**	**2**	**-**	**-**	**-**	**3**		**-**	**-**	**-**	**-**

(20ES0204) Network Analysis (EEE)

I B.Tech . II Sem Syllabus

L	T	P	C
3	0	0	3

Course objective*:* To help students develop an understanding on analyzing electrical circuits using various techniques. To make the student familiarize with the fundamental concepts of coupled circuits, resonance, filters and to analyze the transient response in electric circuits.

UNIT- I Network Topology

Definitions – Graph – Tree, Basic Cutset and Basic Tieset Matrices for Planar Networks – Loop and Nodal Methods of Analysis of Networks & Independent Voltage and Current Sources – Duality & Dual Networks. Nodal Analysis, Mesh Analysis.

UNIT-II RL AND RC CIRCUITS:

The Source free RL Circuit, The Source free RC Circuit, Properties of Exponential Response, Natural & Forced Response, RLC Circuits, Complete Response of Source free parallel RLC Circuits, Source free Series RLC Circuits.

UNIT-III A.C. TRANSIENT ANALYSIS:

Transient Response **of** R-L, R-C, R-L-C Series Circuits for Sinusoidal Excitations - Solution Method Using Differential Equations and Laplace Transforms

UNIT-IV THREE PHASE A.C. CIRCUITS

Three Phase A.C. Circuits Importance of 3 phase circuits – Star, Delta connections – Phase sequence – Balanced load – Relation between voltages, currents of line and phase values in star and delta connection – Problems in balanced loads of star and delta connections – Measurement of 3 phase power using two wattmeter method (Derivation and Problems) – Effects of unbalanced loads in Star and Delta system

UNIT-V FILTERS:

Introduction, the neper & decibel, Characteristic Impedance of symmetrical networks, Currents & voltage ratios as exponentials; the propagation constant, Hyperbolic trigonometry, 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, band Pass Filters ,band reject filters - illustrated problems.

Course Outcomes:

On successful completion of the course, students will be able to		Pos reiated to Cos
CO1	The fundamental concepts of coupled circuits, resonance, filters and to analyze the transient response in electric circuits.	PO1,PO2,PO9
CO2	Given a network, find the equivalent impedance by using network reduction techniques	PO3,PO9
CO3	Determine the current through any element and voltage across any element	PO1,PO2,PO4
CO4	The understand the General case of parallel resonance circuit.	PO1,PO2,PO4,PO9
CO5	Apply the network theorems suitably	PO1,PO2,PO3

.**Text Books:**

1. W H Hayt, J E Kemmerly and S M Durbin, "Engineering Circuit Analysis", Tata McGraw-Hill, 7th edition, 2010.

2.John D. Ryder, "Networks, Lines, and Fields," PHI publications, Second Edition, 2012.

Reference Books:

1. Van Valkenburg, "Network Analysis", PHI, 3rd Edition, 2011.
   N C Jagan & C Lakshminarayana "Network Analysis" BS Publications 3rd Edn.2014

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3							2			
CO2			2						3			
CO3	1	2		3								
CO4	1	2		3					1			
CO5	2	3	2									
Average	**1.25**	**2.5**	**2**	**3**					**2**			

R20-PYTHON PROGRAMMING

Course Objectives:

- Introduction to Scripting Language.
- Exposure to various problems solving approaches of computer science.

UNIT I

Introduction: History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT II

Types, Operators and Expressions: Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while, break, continue, pass.

UNIT III

Data Structures: Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions.

UNIT IV

Functions: Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables.

Modules: Creating modules, import statement, from. Import statement, name spacing.

Python packages: Introduction to PIP, Installing Packages via PIP, Using Python Packages.

UNIT V

Object Oriented Programming OOP in Python: Classes, 'self-variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding,

Error and Exceptions: Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions.

Course Outcomes:

On successful completion of the course, students will be able to		POs related to Cos
CO1	understanding of the Making Software easily right out of the box.	PO1,PO2,PO3,PO5,PO9,PO10,PO12
CO2	The knowledge to about Experience with an interpreted Language.	PO2,PO3,PO5,PO9,PO10
CO3	The understand the To build software for real needs.	PO1,PO3,PO5,PO10,PO12
CO4	Prior Introduction to testing software	PO3,PO5,PO10,PO12
CO5	understand Object Oriented Programming OOP in Python	PO2,PO3,PO5,,PO10

Text Books :

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.

2. Learning Python, Mark Lutz, Orielly.

References:

1. Think Python, Allen Downey, Green Tea Press.

2. Core Python Programming, W.Chun, Pearson.

3. Introduction to Python, Kenneth A. Lambert, Cengage.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2		2				1	1		2
CO2		2	2		2				2	2		
CO3	2		3		2					2		2
CO4			2		1					3		2
CO5		1	2		2					2		
Average	**1**	**1.0**	**2.2**		**1.8**				**0.6**	**2**		**2**

SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. | www.svpcet.org

(20BSBH08)APPLIED CHEMISTRY LAB

(Common to EEE,ECE and CSE)

L	T	P	C
0	0	3	1.5

Course Objectives: The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The student will learn:

- The hygiene aspects of water would be in a position to design methods to produce potable water using modern technology.
- The preparation and properties of synthetic polymers and other material that would provide sufficient impetus to engineer these to suit diverse applications.

LIST OF EXPERIMENTS:

Choice of 10 experiments from the following:

1. Estimation of hardness of water by complexometric method using EDTA.

2. Determination of Alkalinity of water.

3. pH Metry- Analysis of acidic and Basic water samples.

4. Estimation of Dissolved oxygen in water.

5. Estimation of chloride ion in water sample by mohr's method.

6. Determination of strength of an acid in pb-acid battery.

7. Preparation of polymer – bakalite.

8. Determination of strength of given strong acid and strong base solution by conductometric titration.

9. Determination of rate constant of acid catalysed hydrolysis of methyl acetate.

10. Preparation of nano material's by precipitation.

COURSE OUTCOMES	
CO1	Acquired the practical skill to handle the analytical methods with confidence.(PO1,PO2,PO3)
CO2	The desirable limits of various constituents in water analysis and its importance. (PO1, PO2)
CO3	Understand of practical molecular properties such as lead acid batteries, conductance of solutions, etc (PO1, PO2, PO3)
CO4	Analyze the rate constant of a reaction from concentration – time relationships.(PO1,PO2,PO4)
CO5	Analyze the preparations, properties of polymers and nano materials in modern technology. (PO1, PO2, PO3,PO5).
CO6	Follow the ethical principles in implementing the experiments (PO8)
CO7	Do experiments effectively as an individual and as a team member in a group. (PO9)
CO8	Communicate verbally and in written form, the understanding about the experiments. (PO10)
CO9	Continue updating their skill related to analytical methods, lead acid batteries rate constant in implementing experiments in future. (PO12)

REFERENCE BOOKS:

1. Vogel's Text book of Quantitative Chemical Analysis, J. Mendham et al, Pearson Education, Sixth Edition, 2012.
2. Senior practical physical chemistry, B.D. Khosla, A. Gulati and V. Garg (R. Chand & Co.,Delhi).
3. An introduction to practical chemistry, K.K. Sharma and D. S. Sharma (Vikas publishing, N. Delhi).

CO-PO Mapping

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2											
CO2	3	2												
CO3	2	3	2											
CO4	3	2		2										
CO5	2	2	3		3									
CO6								3						
CO7									2					
CO8										3				
CO9												3		
AVEG	**2.6**	**2.4**	**2.3**	**2**	3	-	-	3	2	**3**	-	**3**	**2**	**2**

PYTHON PROGRAMMING LABORATORY-R20

Exercise 1 - Basics

a) Running instructions in Interactive interpreter and a Python Script.

b) Write a program to purposefully raise Indentation Error and correct it.

Exercise 2 - Operations

a) Write a program to compute distance between two points taking input from the user (Pythagorean Theorem).

b) Write a program add.py that takes 2 numbers as command line arguments and prints its sum.

Exercise - 3 Control Flow

a) Write a Program for checking whether the given number is a even number or not.

b) Using a for loop, write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4, . . . ,1/10.

c) Write a program using a for loop that loops over a sequence. What is sequence?

d) Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.

Exercise 4 - Control Flow - Continued

a) Find the sum of all the primes below two million.

Each new term in the Fibonacci sequence is generated by adding the previous two terms. By

starting with 1 and 2, the first 10 terms will be:

1, 2, 3, 5, 8, 13, 21, 34, 55, 89,...

b) By considering the terms in the Fibonacci sequence whose values do not exceed four million, find the sum of the even-valued terms.

Exercise - 5 - DS

a) Write a program to count the numbers of characters in the string and store them in a dictionary data structure

b) Write a program to use split and join methods in the string and trace a birthday with a dictionary data structure.

Exercise - 6 DS - Continued

a) Write a program combine lists that combines these lists into a dictionary.

b) Write a program to count frequency of characters in a given file. Can you use character frequency to tell whether the given file is a Python program file, C program file or a text file?

Exercise - 7 Files

a) Write a program to print each line of a file in reverse order.

b) Write a program to compute the number of characters, words and lines in a file.

Exercise - 8 Functions

a) Write a function ball collide that takes two balls as parameters and computes if they are colliding. Your function should return a Boolean representing whether or not the balls are colliding.

Hint: Represent a ball on a plane as a tuple of (x, y, r), r being the radius

If (distance between two balls centers) <= (sum of their radii) then (they are colliding)

b) Find mean, median, mode for the given set of numbers in a list.

Exercise - 9 Functions - Continued

a) Write a function nearly equal to test whether two strings are nearly equal. Two strings a and b are nearly equal when a can be generated by a single mutation on b.

b) Write a function dups to find all duplicates in the list.

c) Write a function unique to find all the unique elements of a list.

Exercise - 10 - Functions - Problem Solving

a) Write a function cumulative product to compute cumulative product of a list of numbers.

b) Write a function reverse to reverse a list. Without using the reverse function.

c) Write function to compute gcd,lcm of two numbers. Each function shouldn't exceed one line.

Exercise 11 - Multi-D Lists

a) Write a program that defines a matrix and prints.

b) Write a program to perform addition of two square matrices.

c) Write a program to perform multiplication of two square matrices.

Exercise - 12 - Modules

a) Install packages requests, flask and explore them using (pip).

b) Write a script that imports requests and fetch content from the page Eg. (Wiki).

c) Write a simple script that serves a simple HTTP Response and a simple HTML Page.

Course	COURSE OUTCOMES	
Python Programming Lab	CO1	Design the algorithm and flowchart for the given problem. (PO1, PO2,PO3)
	CO2	Develop the programs on control statements and arrays. (PO1, PO2, PO3,PO5)
	CO3	Analyze the concepts on functions and strings. (PO1, PO2,PO9)
	CO4	Solve the memory access problems by using pointers and design the programs on structures and unions. (PO1, PO2, PO4,PO5)
	CO5	Analyze the basics of file handling mechanism that is essential for understanding the concepts of management systems. (PO1, PO2)
	CO6	Follow the ethical principles in implementing the programs (PO8)
	CO7	Do experiments effectively as an individual and as a team member in a group. (PO9)
	CO8	Communicate verbally and in written form, the understanding about the experiments. (PO10)
	CO9	Continue updating their skill related to loops, pointers and files implementing programs in future. (PO12)

References:

1. Think Python, Allen Downey, Green Tea Press.
2. Core Python Programming, W.Chun, Pearson.
3. Introduction to Python, Kenneth A. Lambert, Cengage.

CO-PO Mapping

Course	PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Python Programming Lab	CO1	3	3	2											
	CO2	3	3	3		2									
	CO3	2	3							3					
	CO4	3	2		3	3									
	CO5	3	3												
	CO6								3						
	CO7									2					
	CO8										3				
	CO9												3		
	AVEG	2.8	2.8	2.5	3	2.5	-	-	3	2.5	3	-	3	3	2

SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. | www.svpcet.org

(20MCBH01) ENVIRONMENTAL SCIENCE

(common to all)

I B.Tech II Sem

L	T	P	C
0	0	0	0

Course Objectives:

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures.
- Understanding the environmental policies and regulations

UNIT-I ECOSYSTEMS AND NATURAL RESOURCES:

Definition, Scope and Importance of ecosystem – Structure and function of an ecosystem – Energy flow in the ecosystem – Food chain, 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

NATURAL RESOURCES:

Classification of Resources: Living and Non-Living resources, **Water resources:** use and over utilization of surface and ground water, Dams: benefits and problems. **Mineral resources:** use and exploitation, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non renewable energy sources.

UNIT-II BIODIVERSITY :

Introduction 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.

UNIT-III ENVIRONMENTAL POLLUTION AND CONTROL :
Definition, Cause, effects and control measures of:

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Noise pollution

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.
E– WASTE MANAGEMENT: Definition of E-Waste, Effect of E-Waste on Humans and Environment, Treating and management of E-Wastes.

UNIT – IV SOCIAL ISSUES AND THE ENVIRONMENT:

Water conservation, rain water harvesting, watershed management –its problems and concerns. Climate change, global warming, acid rain, ozone layer depletion,– 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.

UNIT – V HUMAN POPULATION AND THE ENVIRONMENT
Population growth, population explosion, Environment and human health- Relationship between Health, wellness and fitness, Human Rights and duties of a citizen, value education – definition of value, value education in the context of Environment, principles of value Education. Women and child welfare, role of Information Technology in Environment and Human Health.

Course Outcomes:

On successful completion of the course, students will be able to		**POs related to COs**
CO1	Students will get the sufficient information that will clarify modern environmental concepts like equitable use of natural resources, more sustainable life styles etc.	PO5,PO7,PO8,PO9
CO2	Students will realize the need to change their approach so as to perceive our own environmental issues correctly, using practical approach based on observation and self learning	PO5,PO9,PO11
CO3	Students become conversant with the fact that there is a need to create a concern for our environment that will trigger pro-environmental action	PO5,PO7,PO11
CO4	By studying environmental sciences, students is exposed to the environment that enables one to find out solution of various environmental problems encountered on and often.	PO2,PO7,PO12
CO5	At the end of the course, it is expected that students will be able to identify and analyze environmental problems as well as the risks associated with these problems and efforts to be taken to protect the environment from getting polluted	PO5,PO8,PO9,PO12

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela.2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BSPublications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS.Publications.

CO-PO Mapping

PO CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO12
CO1							3	2	2			
CO2					3				2		2	
CO3					3		2				2	
CO4		3					2					3
CO5					3			3	3			3
Average		**3**			**3**		**2.3**	**2.5**	**2.3**		**2**	**3**

Semester – III
Course / Branch: B.Tech-Electrical & Electronics Engineering

S.No	Course Code	Course Title	C	L	T	P	Credits
1	20BSBH12	Mathematics-III	BS	2	1	0	3
2	20PC0205	DC Machines & Transformers	C	3	0	0	3
3	20PC0401	Electronic Devices & Circuits	C	3	0	0	3
4	20PC0206	Electromagnetic Fields	C	3	0	0	3
5	20HSMB01	Economics for Engineers	HS	3	0	0	3
6	20PC0207	Network Theory Laboratory	V Lab	0	0	3	1.5
7	20PC0404	Electronic Devices & Circuit Laboratory	C Lab	0	0	3	1.5
8	20PC0208	DC Machines & Transformers Lab	C Lab	0	0	2	1.5
9	20SO0201	Circuits Simulation & Analysis using PSPICE & MATLAB	SOC	1	0	2	2
		Total					**21.5**
10	20MCBH02	Constitution of India	M	0	0	0	0

Semester – IV
Course / Branch: B.Tech-Electrical & Electronics Engineering

S.No.	Course Code	Course Title	C	L	T	P	Credits
1	20BSBH13	Mathematics-IV	BS	3	0	0	3
2	20ES0505	Data Structures and Algorithms with Python	ES	3	0	0	3
3	20PC0209	Power Systems-I	C	3	0	0	3
4	20PC0403	Digital Electronics	C	3	0	0	3
5	20PC0210	AC Machines	C	3	0	0	3
6	20PC0211	AC Machines lab	C Lab	0	0	3	1.5
7	20PC0212	Electrical Circuits & Simulation Lab	C Lab	0	0	3	1.5
8	20ES0506	Data Structures with Python lab	ES Lab	0	0	3	1.5
9	20SO0202	PLC Design	S	1	0	2	2
		Total					**21.5**
	20IN0201	Internship (Mandatory) for 6 weeks duration during summer vacation					

Course Code			L	T	P	C
20BSBH12	MATHEMATICS-III (Common to EEE & ECE)		3	0	0	3
Pre-requisite	Basic Equations, Differentiations , Integration and Basic Probability	Semester	III			

Course Objectives:

This course aims at providing the student with the knowledge on various numerical methods for solving equations, fitting of curves, interpolating the polynomials, evaluation of integral equations and solution of differential equations. The student develops the idea of using continuous/discrete transforms and the theory of Probability

Course Outcomes (CO): Student will be able to

- Apply numerical methods to solve algebraic, transcendental equations and fitting of curves
- Derive interpolating polynomials using interpolation formulae
- Solve differential and integral equations numerically
- Understand the use of fourier transforms to solve difference equations and apply z-transforms to solve difference equations.
- Demonstrate the ability probability concepts to anaylyse and solve real world problems

UNIT – I	Solution of Algebraic & Transcendental Equations	9 Hrs

Solution of Algebraic and Transcendental Equations: Introduction- Bisection Method – Method of False Position– Newton-Raphson Method.

Curve fitting: Fitting of straight line – Second degree curve-Exponential curve-power curve by method of least squares.

UNIT – II	Interpolation & Numerical Differentiation	8 Hrs

Interpolation: Finite differences-Forward differences- Backward differences- Newton's forward and backward interpolation formulae – Lagrange's formulae.

Numerical Differentiation: Derivatives using Newton's forward and backward difference formula

UNIT – III	Numerical Integration & Solution of Initial value problems to Ordinary differential equations	9 Hrs

Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule.

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

UNIT – IV	Fourier Transforms & Z-Transforms	12 Hrs

Introdution – Fourier integral theorem (only statement) – Fourier sine and cosine integrals-Fourier transform – Fourier sine and cosine transforms – Properties – Inverse transforms.

Z-Transform- Inverse Z-transform- properties-Damping Rule – Shifting rule-Initial and Final value theorem - Convolution theorem –Introdution to difference equations -Solutions of difference equations by Z-transforms.

UNIT – V	**Probability theory**	9 Hrs
Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation.		

Textbooks:

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.
3. Probability & Statistics by T.K.V. Iyengar, S.Chand publications.

Reference Books:

1. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
2. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.
3. Mathematical Methods by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S. Chand publication.
4. Probability and Statistics for Engineering and Sciences by Jay L.Devore, CENGAGE.

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ma14/preview/ noc18ma12.
2. http://nptel.ac.in/courses/111105090/111107056/117101056/17
3. onlinelibrary.wiley.com

CO-PO Mapping:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 12	PSO 12
CO1	**3**	**2**		**2**			**1**				**1**	**2**	**3**	**2**
CO2	**2**	**2**		**1**			**1**					**2**	**2**	**2**
CO3	**3**	**3**		**3**								**2**	**3**	**2**
CO4	**3**	**2**	**2**	**2**			**2**					**2**	**2**	**2**
CO5	**3**	**3**	**2**	**1**			**1**					**1**	**1**	**1**

Course Code	DC MACHINES & TRANSFORMERS		L	T	P	C
20PC0205			3	0	0	3
Pre-requisite		Semester	III			

Course Objectives:

Student will be able to

- Study 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 (CO):

At the end of this course, students will demonstrate the ability to

- Understand the concepts of magnetic circuits, principle and operations of DC machines, starters and single and three phase transformers
- Analyze armature reaction, parallel operation, speed control and characteristics of DC machines. Also analyze the performance characteristics with the help of OC and SC tests of transformer.
- Evaluate generated emf, back emf, speed, efficiency and regulations of DC machines and efficiency and regulation of transformer also load sharing of parallel connected transformers.
- .Understand the principles and functioning of single-phase transformers, including the ability to analyze, design, and troubleshoot transformer circuits for various applications in electrical systems.
- Proficiency in analyzing, designing, and implementing three-phase transformer systems, including a deep understanding of their construction, operation, and application in electrical power distribution

UNIT – I	Principles of electromechanical energy conversion	10Hrs

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.

UNIT – II	DC Generators	9Hrs

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.

UNIT – III	DC Motors	10Hrs

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.

UNIT – IV	Single Phase Transformers	10Hrs

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.

UNIT – V	Three Phase Transformers	9Hrs

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.

Textbooks:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education,2010.

Reference Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002. Online Learning Resources:

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_ee71/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee24/preview

CO-PO Mapping:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 12	PSO 12
CO1	3	2	2	1		3							3	2
CO2	3	2	2	1		3							3	2
CO3	3	2	2	1	2	3							3	2
CO4	3	2	2	1		3							3	2
CO5	2	1	2	2		2							2	2

SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. | www.svpcet.org

Course Code	ELECTRONIC DEVICES AND CIRCUITS		L	T	P	C
20PC0401			3	0	0	3
Pre-requisite		Semester	III			

Course Objectives:

The objectives of this course:

- To understand the characteristics and applications of P-N junction diode, special purpose devices in electronic circuits.
- To familiarize working principle of BJT, JFET and MOSFET and to design single stage amplifier circuits using low frequency model.
- To analyze and design various electronic devices and circuits using PN Junction diode, BJT, JFET and MOSFET.

Course Outcomes (CO):

On successful completion of this course, the student will be able to

- Demonstrate the characteristics of PN Junction Diode, Rectifiers, Filters, BJT, JFET, MOSFET and special purpose electronic devices.
- Analyze numerical and analytical problems in Rectifiers, Filters, Transistor biasing circuits and Transistor amplifiers.
- Design and develop electronic circuits such as Rectifiers with and without filters, Transistor biasing circuits and Transistor amplifiers. Solve engineering problems and arrive at solutions relating to electronic devices and circuits.
- Master the techniques of transistor biasing and thermal stabilization, demonstrating the ability to design and optimize transistor circuits for reliable and stable performance in electronic applications.
- Gain expertise in the integrated circuit fabrication process, demonstrating the ability to comprehend, analyze, and apply techniques involved in the manufacturing of integrated circuits, ensuring a comprehensive understanding of semiconductor device fabrication.

UNIT – I	P-N JUNCTION DIODE	12 Hrs

P-N Junction Diode: Open circuited PN Junction, Forward and Reverse Bias of PN Junction, Current Components in a PN diode, Volt - Ampere Characteristic, Temperature dependence of the V-I characteristic, Breakdown Mechanisms, Zener Diode - Zener Diode as Voltage Regulator, Diode Clippers and Clampers.

UNIT – II	RECTIFIERS	12 Hrs

Rectifiers: Definition and Types, Half Wave Rectifier, Full wave Rectifier and Bridge Rectifier, Comparison of Rectifiers, Filter - Definition and Types, Inductor Filter, Capacitor Filter, L-section Filter, CLC or π - section Filter, Comparison of various types of filters. Special Purpose Devices: Varactor Diode, Tunnel Diode, Uni Junction Transistor, SCR, Solar Cell, LCD, LED.

UNIT – III	TRANSISTOR CHARACTERISTICS	12 Hrs
Transistor Characteristics: BJT: BJT - Construction, Operation, Transistor Current Components, Transistor as an Amplifier, Transistor Characteristics - CB, CE and CC, Eber's moll model FET: Types, JFET - Construction, Working, Characteristics, MOSFET - types, Construction, Working, Characteristics, Comparison between JFET and MOSFET.		
UNIT – IV	**TRANSISTOR BIASING AND THERMAL STABILIZATION**	**10 Hrs**
Transistor Biasing and Thermal Stabilization: Need for Transistor biasing, Operating point, Load line analysis, Biasing methods - Fixed bias, Collector to Base bias, Self-bias, stability factors, Bias compensation, Thermal Runaway, Thermal stability.		
UNIT – V	**INTEGRATED CIRCUIT FABRICATION PROCESS**	**10 Hrs**
Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.		

Textbooks:

1. J. Millman, C. Halkias, "Electronic Devices and Circuits", Tata Mc-Graw Hill, 4thEdition,2010.
2. R.L. Boylestad and Louis Nashelsky,"Electronic Devices and Circuits",Pearson Publications,,9thEdition,2006.
3. S.Salivahanan, N.Suresh Kumar, Electronic Devices and Circuits, McGraw Hill Education (India) Private Limited, 3rdEdition, 2012.

Reference Books:

1. Jacob Millman, C. Halkies, C.D.Parikh, "Integrated Electronics", Tata Mc-Graw Hill, 2009.
2. BV Rao, KBR Murty, K Raja Rajeswari, PCR Pantulu, "Electronic Devices and Circuits", Pearson, 2nd edition.
3. Salivahanan, Kumar, Vallavaraj, "Electronic Devices and Circuits", Tata Mc- Graw Hill, Second Edition

CO-PO Mapping:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 12	PSO 12
CO1	**3**	**1**	**2**	**1**	**1**								**3**	**2**
CO2	**1**	**3**	**2**	**2**	**2**								**2**	**2**
CO3	**1**	**3**	**2**	**2**	**2**								**2**	**2**
CO4	**3**	**3**	**2**	**3**	**1**								**2**	**2**
CO5	**3**	**2**	**3**	**1**	**2**								**1**	**1**

Course Code	ELECTROMAGNETIC FIELDS		L	T	P	C
20PC0206			3	0	0	3
Pre-requisite		Semester	III			

Course Objectives:

To make the student learn about:

- The laws concerning static electric fields: Columb‟s law, Gauss‟s law; the laws concerning static magnetic fields: Biotsavart law, ampere circuital law.
- The Maxwell‟s equations concerned with static electric fields and static magnetic fields.
- The difference between the behaviors of conductors and dielectrics in electric fields, The energy stored and energy density in (i) static electric field (ii) magnetic field.
- Electromagnetic wave propagation and attenuation in various medium and propagation through boundaries between media and Significance of Poyinting theorem with it‟s Vector.

Course Outcomes (CO):

After the end of this course student will

CO1 Gets knowledge on basic principles, concepts and use of fundamental laws like Gauss‟s Law, Coulomb‟s law, Biot-Savart law, ampere circuital law and Poisson‟s Equation to find fields and potentials for a variety of situations including charge distributions and capacitors.

CO2 Able to understand vector algebra, 3-dimensional co-ordinate systems, electrostatics, magneto statics, time-varying fields and interaction between electricity and magnetism.

CO3 Understand the behavior of magnetic and electric fields in the presence of dielectric and magnetic materials; appreciate how to simply modify expressions for capacitance and inductance from free space expressions.

CO4 Acquire a thorough understanding of magnetic potential concepts, demonstrating the ability to apply principles in analyzing magnetic fields, calculating magnetic potential, and solving related engineering problems..

CO5 Develop a comprehensive understanding of time-varying fields, showcasing the capability to analyze, model, and apply principles related to electromagnetic fields and their dynamic behavior in various engineering applications.

UNIT – I	ELECTROSTATICS	12 Hrs

Electrostatic Fields - Coulomb‟s Law - Electric Field Intensity(EFI) due to Line, Surface and Volume charges- Work Done in Moving a Point Charge in Electrostatic Field-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 – Numerical 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 – Numerical Problems.

UNIT – II	CONDUCTORS AND DIELECTRICS	12 Hrs

Behavior of Conductors in an Electric Field-Conductors and Insulators – Electric Field Inside a Dielectric Material – 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.

UNIT – III	MAGNETO STATICS	12 Hrs

Static Magnetic Fields – Biot-Savart Law – Oerstead‟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.

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 – Magnetic Dipole and Dipole moment – A Differential Current Loop as a Magnetic Dipole – Torque on a Current Loop Placed in a Magnetic Field – Numerical Problems.

UNIT – IV	MAGNETIC POTENTIAL	10 Hrs

Scalar Magnetic Potential and Vector Magnetic Potential and its Properties - Vector Magnetic Potential due to Simple Configuration – Vector Poisson‟s Equations. Self and Mutual Inductances – Neumann‟s Formulae – Determination of Self Inductance of a Solenoid and Toroid and Mutual Inductance Between a Straight, Long Wire and a Square Loop Wire in the Same Plane – Energy Stored and Intensity in a Magnetic Field – Numerical Problems.

UNIT – V	TIME VARYING FIELDS	10 Hrs

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 – Uniform Plane Wave Motion in Free Space, Conductors and Dielectrics – Velocity, Wave Length, Intrinsic Impedance and Skin Depth – Poynting Theorem – Poynting Vector and its Significance.

Textbooks:

1. Engineering Electromagnetics by William.H.Hayt, Mc.Graw – Hill, 2010.
2. Electromagnetic Fields by Sadiku – Oxford University Press, 5th Edition, 2010.
3. Field Theory – K.A.Gangadhar, Khanna Publications, 2003.

Reference Books:

1. Electrodynamics by Griffith, PHI, 3rd Edition, 1999.
2. Electromagnetics by J.D.Kraus,Mc.Graw – Hill Inc,5th edition,1999.
3. Electromagnetics by Joseph Edminister, Tata Mc Graw Hill, 2006.

CO-PO Mapping:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 12	PSO 12
CO1	2		2	3	3		1						3	2
CO2			2	3	1	2	1						3	2
CO3	2	2		3	2	1							3	2
CO4	1	1	2	3	3	1							3	2
CO5	2	1	2	3	2	2							3	2

Course Code	Economics for Engineers	L	T	P	C
20HSMB01		3	0	0	3
Pre-requisite		Semester	III		

Course Objectives:

The objectives of this course:

- To equip the student with the basic inputs of Managerial Economics and Economic Environment of business and to equip them with the required tools and techniques for improving their decision- making skills.

Course outcomes (CO):

- Develop a foundational understanding of managerial economics, demonstrating the ability to apply economic principles to managerial decision-making, analyze business scenarios, and optimize resource allocation in a corporate context.
- Master the theory of demand, exhibiting the ability to analyze and interpret factors influencing consumer behavior, quantify demand elasticity, and apply these principles to make informed decisions in various economic contexts.
- Attain proficiency in production analysis, showcasing the ability to analyze and optimize production processes, assess resource utilization, and make informed decisions to enhance efficiency and productivity in various economic settings.
- Gain expertise in market structure and pricing, demonstrating the ability to analyze different market types, formulate pricing strategies, and make informed business decisions to maximize profitability within various economic environments.
- Develop a foundational understanding of macroeconomics, showcasing the ability to analyze and interpret key economic indicators, understand the impact of fiscal and monetary policies.

UNIT – I	**Introduction to Managerial Economics**	12 Hrs

Definition, Nature and Scope, Relationship with other areas in Economics, Production Management, Marketing, Finance and Personnel, Operations research - The role of managerial economist..

UNIT – II	**Theory of Demand**	12 Hrs

Demand Analysis – Law of Demand - Elasticity of demand, types and significance of Elasticity of Demand. Demand estimation – Marketing research approaches to demand estimation. Need for forecasting, forecasting techniques.

UNIT – III	**Production Analysis**	12 Hrs

Production Function, Marginal Rate of Technical Substitution, Iso-quants and Iso- costs, Production function with one/two variables, Cobb-Douglas Production Function, Returns to Scale and Returns to Factors, Economies of scale. Cost concept and types, Determinants of

cost, Cost-Output Function: short run and long run, Break Even Analysis		
UNIT – IV	**Market Structure and Pricing practices**	**10 Hrs**
Features and Types of different competitive situations - Price-Output determination in Perfect competition, Monopoly, Monopolistic competition and Oligopoly. Pricing philosophy – Pricing methods in practice: Price discrimination, product line pricing. Pricing strategies: skimming pricing, penetration pricing, Loss Leader pricing. Pricing of multiple products.		
UNIT – V	**Macro Economics**	**10 Hrs**
National Income: concept and measurement methods Definition and meaning-characteristics of Inflation- types of inflation - effects of inflation - Definition and characteristics of business cycles-phases of business cycle - steps to avoid business cycle		
Textbooks:		
1. Managerial Economics D M.Mithani 2. Managerial Economics Gupta,Tata Mc Graw -Hill		
Reference Books:		
1. Managerial Economics and Financial Analysis, 1/e, Aryasri, TMH, 2013. 2. Managerial Economics,Suma Damodaran,Oxford.		

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 12	PSO 12
CO1	**2**		**1**		**1**	**3**					**2**		**2**	**1**
CO2	**3**	**2**	**2**			**2**				**1**	**2**		**2**	**1**
CO3	**3**					**2**					**2**		**2**	**1**
CO4	**2**	**3**		**3**			**2**				**3**		**2**	**1**
CO5	**3**	**1**		**2**			**1**				**2**		**2**	**1**

Course Code	Network Theory Laboratory		L	T	P	C
20PC0207			0	0	3	1.5
Pre-requisite		Semester	III			

Course Objectives:

The objectives of this course:

- Experimental verification of theorems
- Experimental verification of two port network parameters
- Experimental verification of resonance phenomenon..

Course Outcomes (CO):

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

CO1 Apply suitable theorems for circuit analysis and verify the results theoretically
CO2 Experimental determination of two port network parameters and theoretical verification.
CO3 Measure active and reactive power experimentally and verify the theoretical values.
CO4 Experimentally determine self inductance, mutual inductance and coefficient of coupling Practically determine band width, Q-factor and verify with theoretical values.
CO5 Develop practical expertise in resource management, demonstrating the ability to effectively allocate, utilize, and optimize resources to meet organizational goals and enhance overall operational efficiency.
CO6 Follow the ethical principles in implementation of experiments
CO7 Do Experiments effectively as individual and as team member in a group.
CO8 Communicate verbally and in written form, understanding about the experiments.
CO9 Continue Updating the skills related to contemporary technology

PART B: List of Experiments

(For Laboratory Examination-Minimum of Ten Experiments)

1. Verification of KCL & KVL for any network.
2. Verification of Superposition Theorem with analysis.
3. Verification of Thevenin's Theorem with analysis.
4. Verification of Norton's Theorem with analysis.
5. Verification of Maximum Power Transfer Theorem with analysis.
6. Frequency response of series resonance circuit with analysis and design.
7. Frequency response of parallel resonance circuit with analysis and design.
8. Determination of Self, Mutual Inductances and Coefficient of Coupling
9. Z and Y Parameters
10. Transmission and Hybrid Parameters
11. Measurement of Reactive Power for Star and Delta Connected Balanced Loads
12. Measurement of 3-Phase Power by Two Wattmeter Method for Unbalanced Loads

CO-PO Mapping:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 12	PSO 12
CO1	2	3	2			2							3	2
CO2	3	2	3			1							3	3
CO3	2	3	3		2	1							3	3
CO4	2	2	3		3								3	3
CO5	2	3	2			2							2	3
CO6								3					1	3
CO7									3				2	3
CO8										3			2	3
CO9												3	1	3

Course Code	ELECTRONIC DEVICES AND CIRCUITS LAB		L	T	P	C
20PC0405			0	0	3	1.5
Pre-requisite		Semester	III			

Course Objectives:

The objectives of this course:

- To understand the working of various Semiconductor devices and plot their characteristics.
- Students can find and plot Input & Output characteristics of BJT's and FET's
- To apply basic electronic devices and circuits in real time applications.

Course Outcomes (CO):

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

- Have Practical knowledge on R, L, C Components (ColourCodes)testing, identification, Specifications, Bread Boards, BJT'S,FET'S,LED'S, etc...
- Demonstrate knowledge in different electronic devices and analog circuits.
- Analyze the characteristics of different electronic devices and circuits like Diodes- PN Junction Diode, Zener Diode and Transistors-BJT, FET.
- Design and develop electronic circuits like rectifiers, clippers, clampers, BJT,FE,
- Design and develop electronic circuits like Diodes, BJTs, JFETs, LEDs.
- Follow the ethical principles in implementation of experiments
- Do Experiments effectively as individual and as team member in a group.
- Communicate verbally and in written form, understanding about the experiments.
- Continue Updating the skills related to contemporary technology

List of Experiments

(For Laboratory Examination-Minimum of Ten Experiments)

1. P-N Junction Diode Characteristics (Forward bias & Reverse bias)
2. Zener Diode Characteristics (Forward bias & Reverse bias)
3. Diode clippers, Diode clampers
4. Half-wave Rectifier (without and with filter)
5. Full-wave Rectifier (without and with filter)
6. BJT Input & Output Characteristics (CE Configuration)
7. BJT Input & Output Characteristics (CB Configuration)
8. FET Transfer & Output Characteristics (CS Configuration)
9. FET Transfer & Output Characteristics (CD Configuration)
10. CRO Operation and its Measurements
11. UJT Characteristics

CO-PO Mapping:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 12	PSO 12
CO1	3	3	3	3	3			2	3				3	2
CO2	3	3	3	2	2	1		3	3				3	2
CO3	3	3	3	2	2	1		2	3				3	3
CO4	3	3	3	2	2	1			3				3	3
CO5	2	3	1	2	2	1		3	1				3	3
CO6								3					3	3
CO7									3				3	3
CO8										3			3	3
CO9												3	3	3

Course Code	DC MACHINES & TRANSFORMERS LAB	L	T	P	C
20PC0208		0	0	3	1.5
Pre-requisite		Semester	III		

Course Objectives:

The objectives of this course:

- DC motors and DC Generators
- The speed control techniques of DC motors.
- Testing on 1-phase transformers.

Course Outcomes (CO):

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

- Able to conduct and analyze load test on DC shunt generator.
- Able to understand and analyze magnetization characteristics of DC shunt generator.
- Able to understand and analyze speed control techniques and efficiency of DC machines.
- Able to understand to predetermine efficiency and regulation of single-phase Transformers.
- Able to Separate of losses of single phase transformer
- Follow the ethical principles in implementation of experiments.
- Do Experiments effectively as individual and as team member in a group.
- Communicate verbally and in written form, understanding about the experiments.
- Continue Updating the skills related to contemporary technology.

List of Experiments

(For Laboratory Examination-Minimum of Ten Experiments)

Minimum ten experiments from the following list are required to be conducted

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 shunts 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. Sumner'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 shunts motor.
13. Separation of losses of single phase transformer

CO-PO Mapping:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 12	PSO 12
CO1	2	1	2	3	1	2	3						3	2
CO2			2	3	2	3	1						3	2
CO3	2		1	2	3	1	2						3	2
CO4	2			3	2	1	3						3	2
CO5	3			1	2	1	3						3	2
CO6								3					1	3
CO7									3				2	3
CO8										3			2	3
CO9												3	1	3

Course Code	CONSTITUTION OF INDIA	L	T	P	C
18MCBH03		3	0	0	0
Pre-requisite		Semester	III		

Course Objectives:

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes (CO):

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

UNIT – I	Constitution Law	Hrs

Meaning of the Constitution Law

UNIT – II	Constitution of India	Hrs

Historical Perspective of the Constitution of India. Salient features and characteristics of the Constitution of India.

UNIT – III	Scheme of the fundamental rights	Hrs

The scheme of the Fundamental Duties and its legal status.The Directive Principles of State Policy – Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and the States.

UNIT – IV	Parliamentary Form	Hrs

Parliamentary Form of Government in India – The constitution powers and status of the President of India. Amendment of the Constitutional Powers and Procedure. The historical perspectives of the constitutional amendments in India. Emergency Provisions: National Emergency, President Rule, Financial Emergency.

UNIT – V	Constitutional Scheme in India	Hrs

Local Self Government – Constitutional Scheme in India. Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom under Article 19. Scope of the Right to Life and Personal Liberty under Article 21.

Textbooks:

1. The Constitution of India, 1950 (Bare Act), Government Publication. 2. Framing of Indian Constitution, Dr. S. N. Busi, Dr. B. R. Ambedkar 1st Edition, 2015
Reference Books:
1. Indian Constitution Law, M. P. Jain 7th Edn., Lexis Nexis, 2014. 2. Introduction to the Constitution of India, D.D. Basu, Lexis Nexis, 2015.

Course Code	MATHEMATICS-IV (Common to EEE & ECE)		L	T	P	C
20BSBH13			3	0	0	3
Pre-requisite	Basic Equations, Differentiations & Integration	Semester	IV			

Course Objectives:

This course aims at providing the student to acquire the knowledge on the calculus of functions of complex variables. The student develops the idea of using Residues & special functions.

UNIT – I	Complex variable –Differentiation	9 Hrs

Functions of a complex variable – Continuity – Differentiability – Analytic function and its Properties – Cauchy-Riemann equations in Cartesian and polar coordinates- Harmonic and conjugate harmonic functions – Milne–Thomson method- Conformal mapping: Bilinear transformation - Fixed point – Cross ratio – Determination of bilinear transformation.

UNIT – II	Complex variable –Integration	9 Hrs

Line integral – Evaluation along a path and by indefinite integration – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula- Liouville's theorem.

Complex power series: Radius of convergence – Expansion in Taylor's series- Maclaurin's series and Laurent series- Singular point – Isolated singular point – Pole of order m – Essential singularity.

UNIT – III	Residues	9 Hrs

Evaluation of residue by formula and by Laurent's series – Cauchy's Residue theorem.
Evaluation of integrals of the type

(a) Improper real integrals $\int_{-\infty}^{\infty} f(x)dx$ (b) $\int_{0}^{2\pi} f(sin\theta, cos\theta)d\theta$ (c) $\int_{-\infty}^{\infty} e^{imx} f(x)dx$

UNIT – IV	Special functions-I	9 Hrs

Special Functions: Gamma and Beta Functions – their properties – Evaluation of improper integrals- Series Solutions of ordinary differential equations (Power series and Frobenius Method).

UNIT – IV	Special functions-II	9 Hrs

Bessel functions – Properties – Recurrence relations – Orthogonality- Legendre polynomials – Properties – Rodrigue's formula – Recurrence relations – Orthogonality.

Course Outcomes:

On successful completion of the course, students will be able to	
CO1	Understand the analyticity of complex functions
CO2	Apply cauchy's integral formula and cauchy's integral theorem to evaluate improper integrals along contours.
CO3	evaluate some standard integrals using contour integrals

	CO4	Learn the utilization of beta and gamma functions and its relations
	CO5	Conclude the use of special function in evaluating definite integrals

Textbooks:

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Engineering Mathematics, Volume - III, E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher.
3. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.

Reference Books:

1. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
2. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.
3. Advanced Engineering Mathematics, Peter V.O'Neil, CENGAGE publisher.
4. Advanced Engineering Mathematics by M.C. Potter, J.L. Goldberg, Edward F.Aboufadel
5. Mathematics III by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S.Chand publications

.

Online Learning Resources:

4. https://onlinecourses.nptel.ac.in/noc17_ma14/preview/ noc18ma12.
5. http://nptel.ac.in/courses/111105090/111107056/117101056/17
6. onlinelibrary.wiley.com

CO-PO Mapping:

CO/ PO	PO1	PO2	PO3	PO 4	P O5	PO 6	P O7	PO 8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	2	3	3	3	-		-	--	-	-	-	-	3	2
CO2	2	3	3	3	-	-	-	-	--	-	-	-	3	3
CO3	3	3	3	3	-	-	-	-	--	-	-	-	3	3
CO4	3	3	2	-	-	-	-	-	--	-	-	-	3	2
CO5	3	3	3	-	-	-	-	-	--	-	-	-	3	2
AVG	**2.6**	**3**	**2.8**	3	-	-	-	-	--	-	-	-		

Course Code	DATA STRUCTURES AND ALGORITHMS WITH PYTHON	L	T	P	C
20ES0505		3	0	0	3
Pre-requisite		Semester	IV		

Course Objectives:

This course is aimed at offering fundamental concepts of :

- Data structures and explains how to implement them.
- Primitive and non primitive data structure.
- Basis for understanding various ways of representing data and its usage in different computing applications.

Course Outcomes (CO):

After completion of this course the student be able to :

- Understand the organization of several ADTs and the manipulation.
- Apply Searching, insertion, deletion, traversing of data stored in various data structures.
- Apply different data structures to solve a given problem
- Analyze the efficiency of using different data structures and choose the efficient data structure for solving a given problem.
- Develop new algorithms to solve various problems

UNIT – I	Data Structures Basics	9Hrs

Basic terminology - data, information, data type; data structures - introduction, storage structures–Static storage and Dynamic Storage representations; Classification of data structures; Applications of data Structures. Abstract Data Types. Arrays --The Array Structure Why Study Arrays?-- The Array Abstract Data Type --Implementing the Array --The Python List ---Creating a Python List ---Appending Items ---Extending A List --Inserting Items . --List Slice --Two-Dimensional Arrays --The Array2D Abstract Data Type --Implementing the 2-D Array --The Matrix Abstract Data Type -- Matrix Operations --Implementing the Matrix
Sorting: Selection sort, Bubble sort, Insertion sort, Quick sort, Merge sort. Searching: Linear search and binary search.

UNIT – II	Linked Lists	10Hrs

Introduction, Types of linked list - singly linked list, doubly linked list and circular linked list, representation of linked list, operations of linked list; Traverse forward/reverse order, searching insertion into, deletion from linked lists; Multi lists ;Applications of linked lists.
Case study: polynomials

UNIT – III	Stacks and Queues	10Hrs

Stacks - Introduction, array and linked representations, implementation and their applications; Queues - introduction, array and linked representations, implementation and their applications; types - linear, circular and doubly ended queues - operations; Applications of queues.
Case study: Computer Simulations, Solving a Maze

UNIT – IV	Trees	10Hrs

Introduction, Properties, Binary tree - introduction, properties, array and linked representations; Tree traversals and their implementation; Expression trees; BST - definition and operations; AVL trees- definition and construction of AVL trees; Applications of binary trees, HEAP TREE,THREADED TREE, The 2-3 Tree --Searching --Insertions --Efficiency of the 2-3 Tree Case study: Morse Code		
UNIT – V	**Graphs**	**9Hrs**
Introduction, Properties, Graphs representations - adjacency matrix, adjacency list, set representation, Traversals - breadth first search and depth first search; Applications of graphs HASHING: Introduction, Different hash functions, Collision - collision avoidance, handling methods		

Textbooks:

1. D. Samanta, "Class Data Structures", 2nd edition, Eastern Economic Prentice-hall Private limited Press, 2000.
2. Rance D.Necaise, "Data Structures and Algorithms Using python" , 2016, Publication: Wiley

Reference Books:

1. Elis Horowitz and Sartaj, Sahni, "Fundamentals of Data Structures". Illustrated edition, Computer Science Press, 2006.
2. Mark Allen Weiss, "Algorithms, Data Structures and Problem solving with C++ illustrated", 2nd edition, Addison-Wesley Publishing Company 2002.
3. RG Dromey and Person, "How to Solve it by Computer ", 2nd edition, Impression Education, 1998.

CO-PO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	2	2	3	3							3	3	2
CO 2	3	3	2	3	3							2	3	2
CO 3	3	3	2	3	3							3	3	2
CO 4	3	2	2	2	3							2	3	2
CO 5	3	2	2	2	3							3	3	2
AVG	**3**	**2.4**	**2**	**2.6**	**3**							**2.6**	**3**	**2**

Course Code	POWER SYSTEM – I	L	T	P	C
20PC0209		3	0	0	3
Pre-requisite		Semester	IV		

Course Objectives:

To understand the different types of power generating stations.
- To examine A.C. and D.C. distribution systems.
- To understand and compare overhead line insulators and Insulated cables.
- To illustrate the economic aspects of power generation and tariff methods.
- To evaluate the transmission line parameters calculations
- To understand the concept of corona

Course Outcomes (CO):

At the end of this course, students will demonstrate the ability to understand the concepts of power systems.
- Understand the operation of conventional generating stations and renewable sources of electrical power.
- Evaluate the power tariff methods.
- Determine the electrical circuit parameters of transmission lines
- Understand the layout of substation and underground cables and corona.
- Understand AC and DC Distribution systems.

UNIT – I	Generation of Electric Power Conventional Sources	9Hrs

Generation of Electric Power Conventional Sources (Qualitative): Hydro station, Steam Power Plant, Nuclear Power Plant and Gas Turbine Plant. Non-Conventional Sources (Qualitative): Ocean Energy, Tidal Energy, Wave Energy, wind Energy, Fuel Cells, and Solar Energy, Cogeneration and energy conservation and storage

UNIT – II	Economics of Generation	10Hrs

Economics of Generation: Introduction, definitions of connected load, maximum demand, demand factor, load factor, diversity factor, Load duration curve, number and size of generator units. Base load and peak load plants. Cost of electrical energy-fixed cost, running cost, Tariff on charge to customer.

UNIT – III	Overhead Line Insulators & Insulated Cables	10Hrs

Overhead Line Insulators & Insulated Cables: Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, testing of insulators. Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables.

UNIT – IV	Inductance & Capacitance Calculations of Transmission Lines	10Hrs

Inductance & Capacitance Calculations of Transmission Lines: Line conductors, inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing, Composite conductors-transposition, bundled conductors, and effect of earth on capacitance. Corona: Introduction, disruptive critical voltage, corona loss, Factors affecting corona loss and methods of reducing corona loss, Disadvantages of corona, interference between power and Communication lines.

UNIT – V	A.C & D.C Distribution	9Hrs

A.C. Distribution: Introduction, AC distribution, Single phase, 3-phase, 3 phase 4 wire system, bus bar arrangement, Selection of site for substation. 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.

DC Distribution: Classification of Distribution Systems.- Comparison of DC vs. AC and Under-Ground vs. Over- Head Distribution Systems.- Requirements and Design features of Distribution Systems.- Voltage Drop Calculations (Numerical Problems) in D.C Distributors for the following cases: Radial D.C Distributor fed one end and at the both the ends (equal/unequal Voltages) and Ring Main Distributor.

Textbooks:

1. W.D.Stevenson –Elements of Power System Analysis, Fourth Edition, McGraw Hill, 1984.
2. C.L. Wadhwa –Generation, Distribution and Utilization of Electrical Energy, Second Edition, New Age International, 2009.

Reference Books:

1. C.L. Wadhwa –Electrical Power Systems, Fifth Edition, New Age International, 2009
2. M.V. Deshpande –Elements of Electrical Power Station Design, Third Edition, Wheeler Pub. 1998
3. H.Cotton& H. Barber-The Transmission and Distribution of Electrical Energy, Third "V.K Mehta and Rohit Mehta", "Principles of Power Systems", S. Chand& Company Ltd, New Delhi, 2004.

CO-PO Mapping:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	1	2	3	2								3	3
CO2	2	3	2	3	3	3	3						3	2
CO3	1	3	2	1									3	3
CO4	1		2	1	3		3						3	3
CO5	2		3	1	2		2	1					3	3

Course Code		L	T	P	C

(20PC0403)	DIGITAL ELECTRONICS	3	1	0	3
Pre-requisite	**Semester**	**IV**			

Course Objectives:

- To provide fundamental concepts used in the design of digital systems and learn the methods for the design of digital circuits
- To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
- To prepare students to perform the analysis and design of various digital electronics circuits.

Course Outcomes (CO):

After the successful completion of this course, the student able to:		Pos related to Cos
CO1	Demonstrate the knowledge of various number systems ,complements of numbers ,code conversions and logic gates to implement digital circuits	**PO1,PO2,PO3,PO12**
CO2	Implement various K- maps , Design & analyze the implementation of NAND and NOR logic gates , various practical problems using logic gates.	**PO1,PO2,PO3**
CO3	Design and analyze combinational circuits adders, subtractors ,comparators , Encoders, Decoders , Multiplexers & Demultiplexers	**PO1,PO2,PO3,PO4,PO5**
CO4	Design and implementation of sequential circuits using clocked flip flops, design different types of counters, Registers.	**PO1,PO2,PO3,PO4, PO5**
CO5	Understand the concepts of memories, implement the various logic families and apply it to solve real life problems.	**PO1,PO2,PO3,PO12**

UNIT – I	NUMBER SYSTEM	9Hrs

Introduction to number system, Number base conversions, Binary Arithmetic, Complements of numbers, Signed binary numbers, binary codes-excess 3 code, BCD, Gray to binary conversion& vice-versa. Digital Logic gates& its realization using universal gates.

UNIT – II	BOOLEAN ALGEBRA	10Hrs

BOOLEAN ALGEBRA

Boolean Algebra-Basic definition, Basic theorems and properties, BooleanFunctions, Canonical & Standard forms- POS & SOP Simplification.

GATE LEVEL MINIMIZATION

The map method, four variable, K-map, Five variable map, Don't careConditions, Tabular Method- NAND-NOR Implementations ,Simplification of Boolean function using tabulation Method.

UNIT – III	COMBINATIONAL CIRCUITS:	10Hrs

Combinational circuits, Analysis & Design procedure, Binary Adder-subtractor, Encoders & Decoder, Magnitude comparators,7-segment display, Multiplexers & Demultiplexers.

UNIT – IV	SEQUNTIAL CIRCUITS:	10Hrs

Sequential Circuits, Latches Flips-Flops-SR, D, JK& T, Master-Slave JK flip-flop. Need for Registers, Shift Registers-bidirectional & Universal .Counters- Ripple Counters, Synchronous

counters & other counters. Analysis & Design of clocked sequential circuits-mealy & Moore circuit, state diagram, state table, state reduction & state assignment.		
UNIT – V	**LOGIC FAMILIES & MEMORIES**	**9Hrs**
Memories: Types of memory-Random Access Memory (RAM), Read Only Memory (ROM),PLA, PAL & PROM. Logic families and their characteristics-RTL, TTL, ECL &CMOS circuits , FPGA		
Textbooks:		
1. M.Morris Mano & Michel D. Ciletti, "Digital Design" ,Pearson ,5th Edition. 2. "Switching theory & Logic Design" by A.P.Godse ,Technical publications ,Pune.		
Reference Books:		
1. Subratha Goshal, "Digital Electronics", Cambridge. 2. Zvi KOhavi and Nirah K.Jha, "Switching theory and Finite Automata Theory",Cambridge,3rd Edition. 3.A.Anand Kumar ―Fundamentals of Digital Circuits‖, 4th Edition, PHI Learning PrivateLimited, 2016.		

CO-PO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	2	-	-							3	3	2
CO2	3	3	3	-	-							2	2	2
CO3	3	3	3	3	3							3	3	3
CO4	3	2	3	3	2							3	3	3
CO5	3	2	3	-	-							2	3	3
SUM	15	13	14	6	5	0	0	0	0	0	0	13	14	13
AVG	3	2.6	2.8	3	2.5	0	0	0	0	0	0	2.6	2.8	2.6

Course Code	AC MACHINES	L	T	P	C
20PC0210		3	0	0	3
Pre-requisite		Semester	IV		

Course Objectives:

The students will be able to:

- 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 (CO):

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

- Understand the basics of ac machine windings, construction, principle of working, equivalent circuit of induction and synchronous machines.
- Analyze the phasor diagrams of induction motor.
- Apply the concepts to determine synchronous machine, parallel operation of alternators, synchronization and load division of synchronous generators
- Analyze the various methods of starting in synchronous motor.
- Analyze the various single phase induction motors.

UNIT – I	Fundamentals of AC machine windings	9Hrs

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.

UNIT – II	Induction Machines	10Hrs

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, crawling and cogging. Analysis of 3 phase induction motors with single phasing operation.

UNIT – III	Synchronous generators	10Hrs

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.

UNIT – IV	Synchronous motors	10Hrs

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

UNIT – V	Single-phase induction motors	9Hrs

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.

Textbooks:

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

Reference Books:

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

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_ee13/preview

CO-PO Mapping:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2		2	3	1	2	3						3	3
CO2				3	2	3	1						3	2
CO3	2		2	3	2		3						3	3
CO4	2			3	2	1	3						3	2
CO5	2	1	2	3	1	2							3	2

SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. | www.svpcet.org

Course Code	AC MACHINES LAB	L	T	P	C
20PC0211		0	0	3	1.5
Pre-requisite		Semester	IV		

Course Objectives:

The students will be able to:

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

methods.

- Predetermine the regulation of Alternator by Zero Power Factor method X_d and Xq determination of salient pole synchronous machine.
- Evaluate and analyze V and inverted V curves of 3 phase synchronous motor

Course Outcomes (CO):

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

- Able to conduct and analyze load test on DC shunt generator.
- Able to understand and analyze magnetization characteristics of DC shunt generator.
- Able to understand and analyze speed control techniques and efficiency of DC machines.
- Able to understand to predetermine efficiency and regulation of single-phase Transformers.
- Able to determine X_d and X_q of a salient pole synchronous machine.
- Follow the ethical principles in implementation of experiments
- Do Experiments effectively as individual and as team member in a group.
- Communicate verbally and in written form, understanding about the experiments.
- Continue Updating the skills related to contemporary technology

List of Experiments
(For Laboratory Examination-Minimum of Ten Experiments)

All the following ten experiments are required to be conducted

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 X_d and X_q of a salient pole synchronous machine by slip test.
10. V and inverted V curves of a 3-phase synchronous motor.

CO-PO Mapping:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	1		2	3	3		3						3	2
CO2	2	1		2	3	3							3	2
CO3		1	2	2	3	3	3						3	2
CO4	1	1		2			3						3	2
CO5	3	2		2			3						3	2
CO6								3					1	2

CO7									**3**				**2**	**2**
CO8										**3**			**2**	**2**
CO9												**3**	**1**	**2**

Course Code	ELECTRICAL CIRCUITS & SIMULATION LAB	L	T	P	C
20PC0212		0	0	3	1.5
Pre-requisite		Semester	IV		

Course Objectives:

The course should enable the students to:

- Design filters and analyze through digital simulation in electrical circuits.
- The objective of Simulation laboratory is to impart hands on experience in verification of circuit laws and theorems, measurement of circuit parameters, study of circuit characteristics using PSPICE and MATLAB.

Course Outcomes (CO):

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

CO1: Evaluate two port network parameters and the transient response for series RL, RC, RLC electric circuits.
CO2: Design filters through digital simulation in electrical circuits.
CO3: Be able to verify the laws and principles of electrical circuits, understand the relationships and differences between theory and practice;
CO4: Be able to gain practical experience related to electrical circuits,
CO5: Simulate and analyse electrical circuits using PSPICE
CO6:Follow the ethical principles in implementation of experiments
CO7:Do Experiments effectively as individual and as team member in a group.
CO8:Communicate verbally and in written form, understanding about the experiments.
CO9: Continue Updating the skills related to contemporary technology

List of Experiments
(For Laboratory Examination-Minimum of Ten Experiments)

All the following ten experiments are required to be conducted

1. Design of Low Pass And High Pass Filters Using MATLAB.
2. Transient Response of series and parallel RLC circuit By MATLAB.
3. Transient Response of series and parallel RL and RC Circuits By MATLAB.
4. MATLAB simulation of R, RL, RC and RLC circuits with DC excitations
5. MATLAB simulation of R, RL, RC and RLC circuits with AC excitations.
6. PSPICE simulation of nodal analysis for DC circuits
7. PSPICE simulation of maximum power transfer theorem for DC circuits
8. PSPICE simulation of superposition theorem for DC circuits
9. PSPICE simulation of AC circuits.
10. Analysis of three phase circuit representing generator transmission line and load

CO-PO Mapping:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	2			3							3	3	1
CO2	3	2			3							2	3	1
CO3	3	2			3							2	3	1

CO4	3	2			3							2	3	1
CO5	3	3			3							2	3	1
CO6								3					1	1
CO7									3				2	1
CO8										3			1	1
CO9												3	2	1

Course Code	Data structures & Algorithms LAB	L	T	P	C
20ES0506		0	0	3	1.5
Pre-requisite		Semester	IV		

Course Objectives:

- To design programs using arrays, strings, pointers and structures.
- To illustrate the use of Stacks and Queues
- To apply different operations on linked lists.
- To demonstrate the Binary tree traversal techniques.
- To design searching and sorting techniques

Course Outcomes (CO):

At the end of this unit, the student will be able to

- Demonstrate basic concepts of C programming language.
- Develop C programs using functions, arrays, structures and pointers.
- Illustrate the concepts Stacks and Queues.
- Design operations on Linked lists.
- Apply various Binary tree traversal techniques.
- Develop searching and sorting methods.
- Follow the ethical principles in implementing the programs
- Do experiments effectively as an individual and as a team member in a group
- Communication verbally and in written from the understanding about the experiments Continue updating their skills related to dynamic memory utilization, sorting, searching

List of Experiments
(For Laboratory Examination-Minimum of Ten Experiments)

All the following ten experiments are required to be conducted

1. Write a python program to implement the following sorting methods to arrange a given list of data items (number of data items >=5000) in ascending / descending order
   a. Selection sort
   b. Insertion sort
   c. Bubble sort
   d. Measure the performance of each of the above sorting technique and compare with their theoretical time complexities
2. Write a python program to implement the following sorting methods to arrange a given list of data items (number of data items >=5000) in ascending / descending order.
   a. Quick Sort
   b. Merge sort
   c. Measure the performance of each of the above sorting techniques and compare with their theoretical time complexities
3. Write python program to implement the following search techniques on a given list of data items organized in the form of array
   a. Linear Search
   b. Binary search
   c. Analyze the performance of each searching technique and write down your observations.

4. Write a python program to perform the following operations on Singly Linked List:
   d. Create a singly linked list
   e. Count the number of nodes in SLL
   f. Insertion and deletion operations at Front at end and at a given position.
   g. Search a given element (KEY) in SLL

5. Write a python program to perform the following operations on Doubly linked list
   h. Create a doubly linked list
   i. Count the number of nodes in DLL
   j. Insertion and Deletion operations at Front, at end and at a given position Traversal
   k. Search a given element (KEY) in DLL

6.Write a python program to implement the STACK using an array and linked list and perform following operations
   a. PUSH an element on to a stack
   b. POP an element from a stack
   c. Demonstrate how stack can be used to check given string in Palindrome
   d. Demonstrate Overflow and Underflow situations on Stack.

7. Write a python program to evaluate POSTFIX expression using STACK

8.Write a python program to implement Queue by using an array and linked list and following operations
   a. Enqueue : add element to end of queue
   b. Dequeue: remove element from front of queue
   c. isEmpty: check if queue is empty
   d. IsFull: check if queue is full

9.Write a python program to implement following operations on Binary Search Tree(BST)
   a. Create a BST on N integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2
   b. Traverse the BST in inorder, preorder and post order
   c. Search a given element (KEY) in BST and report the appropriate message.

10.Write a python program for implementing the following graph traversal techniques
   a. Depth first search traversal
   b. Breadth first search traversal
   c. Measure the time required to perform each traversal operation.

CO-PO Mapping

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PsO 1	PsO 2
CO1	3												3	
CO2	2	2											3	
CO3		2	3											
CO4	2			2										
CO5				3										
CO6								3					1	
CO7									2				2	
CO8										3			2	
CO9												3	1	
AVG	**2.3**	**2**	**3**	**2.5**	-	-	-	3	2	**3**	-	**3**	**2**	

SEMESTER – V

COURSE / BRANCH: B.TECH-ELECTRICAL & ELECTRONICS ENGINEERING

S. No.	Course Code	Course Title	C	L	T	P	Credits
1	20PC0213	Power Systems II	PC	3	-	-	3
2	20PC0214	Power Electronics	PC	3	-	-	3
3	20PC0215	Control Systems	PC	3	-	-	3
4	20PE0201	Power Quality	PE/JOE-I	3	-	-	3
	20PE0202	Electrical Distribution Systems/MOOC					
	20PE0203	Programmable Logic Controllers					
	20PC0403	Signals and Systems					
5	XXXXXX	Open Elective - I	OE/JOE-I	3	-	-	3
6	20PC0216	Control Systems and simulation Lab	PC LAB	-	-	3	1.5
7	20PC0217	Power Electronics and simulation Lab	PC LAB	-	-	3	1.5
8	20SO0203	Soft Skills	SSC LAB	-	-	3	2
9	20IN0201	Internship	INTERSHIP	-	-	-	1.5
		Total		15	0	9	21.5

CATEGORY	
PC	12
OE	3
PE	3
INTERSHIP	1.5
SSC	2
TOTAL CREDITS	21.5

SEMESTER – VI

COURSE / BRANCH: B. TECH-ELECTRICAL & ELECTRONICS ENGINEERING

S. No.	Course Code	Course Title	C	L	T	P	Credits
1	20PC0218	Electrical Measurements and Instrumentation	PC	3	-	-	3
2	20PC0219	Power System Analysis	PC	3	-	-	3
3	20PC0414	Micro Processors and Micro Controllers	PC	3	-	-	3
4	20PE0204	Modern Control Theory	PE-II	3	-	-	3
	20PE0205	Industrial Automation and Control					
	20PE0206	Power Electronics and Distributed Generation					
	20PE0207	Power System Operation and Control					
5	XXXXXX	Open Elective – II	OE/ JOE-II	3	-	-	3
6	20PC0220	Electrical Measurements and Instrumentation Laboratory	PC LAB	-	-	3	1.5
7	20PC0221	Computer Aided Design Laboratory	PC LAB	-	-	3	1.5
8	20PC0416	Micro Processors and Micro Controllers Lab	PC LAB	-	-	3	1.5
9	20SO0204	Skill Oriented Lab	SSC LAB	-	-	4	2
10	XXXXXX	Social Ethics		1	-	-	0
		Total		16	0	13	21.5

CATEGORY	
PC	13.5
OE	3
PE	3
SOC	2
TOTAL CREDITS	21.5

SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. | www.svpcet.org

SEMESTER – VII

COURSE / BRANCH: B.TECH-ELECTRICAL & ELECTRONICS ENGINEERING

S. No.	Course Code	Course Title	C	L	T	P	Credits
1	20PE0208	Utilization of Electrical Energy	PE-III	3	-	-	3
	20PE0209	Power Systems Stability					
	20PE0210	High Voltage Engineering					
	20PE0211	Power System Transients					
2	20PE0212	Electrical Drives	PE-IV	3	-	-	3
	20PE0213	HVDC Transmission					
	20PE0214	Flexible Alternating Current Transmission Systems					
	20PE0215	Advanced Power System Protection					
3	20PE0216	Smart Grid Technology/ MOOC(Smart Grid- Basics to advanced technologies)	PE-V	3	-	-	3
	20PE0217	Energy Audit and Management					
	20PE0218	Digital Image Processing					
	20PE0219	Electric and Hybrid Vehicles					
4	XXXXXX	Open Elective – III/Software Engineering	OE- III	3	-	-	3
5	XXXXXX	Open Elective – IV/Introduction to Micro Electro Mechanical Systems	OE-IV	3	-	-	3
6	20MC0201	MOOC/Advanced Linear Continuous Control Systems	MOOC	3	-	-	3
8	20SO0205	Skill Oriented Lab	SSC LAB	-	-	4	2
9	20CV020	Comprehension Vivo Voce	CVV	-	-	-	1

	1						
		Total		15	0	10	21

CATEGORY	
PE	12
OE	6
CVV	1
SOC	2
TOTAL CREDITS	21

SEMESTER – VIII

COURSE / BRANCH: B.TECH-ELECTRICAL & ELECTRONICS ENGINEERING

S. No.	Course Code	Course Title	C	L	T	P	Credits
1	20PR0201	PROJECT	PRO	07	-	07	14

OPEN ELECTIVE-I

S. No.	Course Code	Course Title
1	20OE0301	Introduction to Operation Management
2	20OE0302	Product Design
3	20OE0303	Energy Management
4	20OE0401	Digital Electronics and Microprocessor
5	20OE0402	Introduction to Communication Systems
6	20OE0403	Embedded Systems and its Applications
7	20OE0501	OOPS Using Java
8	20OE0502	Computer Organization
9	20OE0503	Design and Analysis of Algorithms

OPEN ELECTIVE-II

S. No.	Course Code	Course Title
1	20OE0304	Introduction to Vehicle Technology
2	20OE0305	Smart Materials

3	20OE0306	Optimization Techniques
4	20OE0404	Introduction to Networking
5	20OE0405	VLSI Design and its Applications
6	20OE0406	Introduction to IOT
7	20OE0504	Computer Networks
8	20OE0505	Object Oriented Analysis and Design
9	20OE0506	Database Management Systems

OPEN ELECTIVE-III

S. No.	Course Code	Course Title
1	20OE0307	Robotics
2	20OE0308	Nano Technology
3	20OE0309	Green Energy Systems
4	20OE0407	Industrial Nano Technology
5	20OE0408	Image Processing
6	20OE0409	Bio Medical Electronics
7	20OE0507	Operating System
8	20OE0508	Software Engineering
9	20OE0509	Human Computer Interaction

OPEN ELECTIVE-IV

S. No.	Course Code	Course Title
1	20OE0310	3D Printing Technology
2	20OE0311	Total Quality Management
3	20OE0312	Non-Destructive Testing
4	20OE0410	Digital Audio Engineering
5	20OE0411	Space Time Wireless Communications
6	20OE0412	Introduction to MEMS
7	20OE0510	Ethical Hacking
8	20OE0511	Machine Learning
9	20OE0512	Distributed Databases

OPEN ELECTIVES OFFERED BY DEPARTMENT TO OTHER BRANCH STUDENTS

OPEN ELECTIVE-I

S. No.	Course Code	Course Title
1	20OE0201	Renewable Energy Sources
2	20OE0202	Introduction to Power Electronics
3	20OE0203	Electrical Power Generation

OPEN ELECTIVE-II

S. No.	Course Code	Course Title
1	20OE0204	Introduction to High Voltage Engineering
2	20OE0205	Electrical Power Quality
3	20OE0206	Electrical Transmission System

OPEN ELECTIVE-III

S. No.	Course Code	Course Title
1	20OE0207	Introduction to Electrical Drives
2	20OE0208	Distribution Systems
3	20OE0209	Utilization and Traction Systems

OPEN ELECTIVE-IV

S. No.	Course Code	Course Title
1	20OE0210	Introduction to Power System Protection
2	20OE0211	Power System Analysis and Operation
3	20OE0212	Circuits and Synthesis

POWER SYSTEMS - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0213	PROFESSIONAL CORE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0	Practical Classes: 48			Total Classes: 48			

OBJECTIVES:

The objectives of the course are to make the student learn about

- Classification of transmission lines and representation by suitable equivalent circuits
- The different types of electromagnetic relays and microprocessor-based relays
- The protection of Generators, Transformers and feeders.
- The technical aspects involved in the operation of circuit breakers

UNIT-I	MODELLING AND PERFORMANCE OF TRANSMISSION LINES:	Classes:9

Classification of transmission lines: Short, medium and long line and their model representations, nominal T, nominal π and A, B, C, D constants for symmetrical and asymmetrical networks, numerical problems, mathematical solutions to estimate regulation and efficiency of all types of lines, numerical problems; Long transmission line: Rigorous solution, evaluation of A, B, C, D constants, numerical problems, Ferranti effect, surge impedance and surge impedance loading of long lines.

UNIT - II	MECHANICAL DESIGN OF TRANSMISSION LINES	Classes:10

Sag and tension calculations: Sag and tension calculations with equal and unequal heights of towers, effect of wind and ice on weight of conductor, numerical problems, stringing chart and sag template and its applications.

Substation: Classification of substations, substation equipments, bus bar arrangement and bus-bar schemes.

UNIT - III	PROTECTIVE RELAYS	Classes:9

Principle of operation, basic requirements of relay, primary & backup protection, Classification of relay.

Electromagnetic relays:, construction of attracted armature, balanced beam, induction disc and induction cup relays; Relays classification: instantaneous, definite minimum time and inverse definite minimum time relays, direction relays- over current / under voltage relays/earth fault relay, differential relays and percentage differential relays, universal torque equation.

Distance relays: Impedance, reactance, mho relays, characteristics of distance relays.

Static relays: Overview of static relay, block diagram, operating principle and comparison, static relays versus electromagnetic relays.

UNIT - IV	**PROTECTION OF GENERATORS, TRANSFORMERS AND FEEDERS**	**Classes:10**

Introduction to generator faults-Protection of Generators Against Stator Faults, over current and over voltage protection, Rotor Faults protection.

Protection of Transformers: Buchholz protection, Over load protection, Differential protection, Biased differential protection.

Protection of feeders: Over load protection, Over current and Earth-Fault protection – current balance differential and voltage balance Merz-Price protection

UNIT - V	**CIRCUIT BREAKERS**	**Classes:10**

Circuit Breakers: Elementary Principles of Arc Interruption, Restriking Voltage and Recovery Voltage - Restriking Phenomenon, Average and Max. RRRV, Numerical Problems - 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.

Text Books:

1. Electrical power systems, C.L.Wadhwa, New Age International (P) Limited, 6th Edition, 2010, Reprint 2014.
2. A Text Book on Power System Engineering, M.L.Soni, J.B.Gupta, U.S.Bhatnagar and A.Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd., 1999.
3. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, TMH Publications, 2011.
4. Switchgear and Protection, Sunil S Rao, Khanna Publishers, 1992.

Reference Books:

1. Power system Analysis 4th edition, John J Grainger and William D Stevenson, JR, Mc Graw Hill Education, 2003, Reprint 2015.
2. Power System Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill Education (India) Pvt. Ltd., 2nd Edition, 2008, 23rd Reprint 2015.
3. Electric Power Transmission System Engineering: Analysis and Design, TuranGonen, 2nd Edition, CRC Press, Taylor & Francis group, 2009, 1st Indian Reprint 2010

4. Transmission network Protection, Y.G. Paithankar ,Taylor and Francis,2009.
5. Power system protection and switch gear, BhuvaneshOza, TMH, 2010.

Course Outcome:

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

CO1 analyze and model transmission line and can determine the performance of line.

CO2: study mechanical design of transmission line and grounding.

CO3: understand and analyze the concepts of different types of relay operations.

CO4: understand and analyze the concepts of protection systems of Generators, Transformers and Feeders.

CO5: understand and differentiate different types of circuit breakers and their applications.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	3		1	1					1	2	3
CO 2	3	2	3	3		2	1					1	1	3
CO 3	2	1	1	1		1	1					1	2	2
CO 4	3	1	1	2		1	1					1	2	3
CO 5	3	1	1	2		1	1					1	3	2
AV G	2.7	1.5	1. 7	2.2		1. 2	1					1	2	2.6

POWER ELECTRONICS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0214	PROFESSIONAL CORE	3	-	-	3	40	60	100
Contact Classes:48	Tutorial Classes: 0	Practical Classes: 0			Total Classes: 48			

OBJECTIVES:

The course should enable the students to:

The objectives of the course are to make the student learn about

- the basic power semiconductor switching devices and their principles of operation.
- the various power conversion methods, controlling and designing of power converters.
- the applications of Power electronic conversion to domestic, industrial, aerospace, commercial and utility systems etc.
- the equipment used for DC to AC, AC to DC, DC to Variable DC, and AC to Variable frequency AC conversions.

UNIT-I	POWER SEMI CONDUCTOR DEVICES	Classes: 10

Semiconductor Power Diodes, Classification of Switching Devices Based on Frequency and Power Handling Capacity-BJT – Power Transistor - Power MOSFET – Power IGBT -Thyristors – Silicon Controlled Rectifiers (SCR's) – Basic Theory of Operation of SCR – Static Characteristics – Turn On and Turn Off Methods- Dynamic Characteristics of SCR - Two Transistor Analogy – Triggering Circuits—— Series and Parallel Connections of SCR's – Snubber Circuits.

UNIT - II	PHASE CONTROLLED CONVERTERS	Classes: 10

Phase Control Technique – Single Phase Line Commutated Converters – Mid Point and Bridge Connections – Half Controlled Converters, Fully Controlled Converters with Resistive, RL Loads and RLE Load– Derivation of Average Load Voltage and Current –

Active and Reactive Power Inputs to the Converters without and with Free Wheeling Diode, Effect of Source Inductance – Numerical Problems. Three Phase Line Commutated Converters – Three Pulse and Six Pulse Converters – Mid Point and Bridge Connections - Average Load Voltage with R and RL Loads – Effect of Source Inductance–Dual Converters (Both Single Phase and Three Phase) - Waveforms – Numerical Problems.

UNIT - III	**CHOPPERS AND REGULATORS**	**Classes: 9**

Commutation Circuits – Time Ratio Control and Current Limit Control Strategies – Step Down and Step up Choppers Derivation of Load Voltage and Currents with R, RL and RLE Loads- Step Up Chopper – Load Voltage Expression– Problems. Study of Buck, Boost and Buck-Boost regulators.

UNIT - IV	**INVERTERS**	**Classes: 9**

Inverters – Single Phase Inverter – Basic Series Inverter – Basic Parallel Capacitor Inverter Bridge Inverter – Waveforms – Simple Forced Commutation Circuits for Bridge Inverters – Single Phase Half and Full Bridge Inverters-Pulse Width Modulation Control-Harmonic Reduction Techniques-Voltage Control Techniques for Inverters – Numerical Problems, Three Phase VSI in 120^0 And 180^0 Modes of Conduction.

UNIT - V	**AC VOLTAGE CONTROLLERS & CYCLO CONVERTERS**	**Classes: 10**

AC Voltage Controllers – Single Phase Two SCR's in Anti Parallel – With R and RL Loads – Modes of Operation of TRIAC – TRIAC with R and RL Loads – Derivation of RMS Load Voltage, Current and Power Factor Wave Forms – Firing Circuits - Numerical Problems - Thyristor Controlled Reactors; Switched Capacitor Networks.

Cyclo Converters – Single Phase Mid Point Cycloconverters with Resistive and Inductive Load (Principle of Operation only) – Bridge Configuration of Single Phase Cycloconverter (Principle of Operation only) – Waveforms

Text Books:

1. Power Electronics, M. D. Singh and K. B. Khanchandani, Mc Graw Hill Education (India) Pvt. Ltd., 2nd Edition, 2007, 23rd Reprint 2015.
2. Power Electronics: Circuits, Devices and Applications, Muhammad H. Rashid, Pearson, 3rd Edition, 2014, 2nd Impression 2015.

Reference Books:

1. Power Electronics, K. R. Varmah, Chikku Abraham, CENGAGE Learning, 1st Edition, 2016.
2. Power Electronics, P. S. Bimbhra, Khanna Publishers, 2012.
3. Power Electronics: Devices, Circuits, and Industrial Applications, V. R. Moorthi, OXFORD University Press, 1st Edition, 2005, 12th Impression 2012.

Course Outcome:

After going through this course, the student acquires knowledge about:

- Basic operating principles of power semiconductor switching devices.
- the operation and analysis of power electronic converter circuits.
- the operation and analysis of choppers and regulator circuits.
- the operation and analysis of inverter circuits.
- the operation and analysis of AC voltage controllers, and cycloconverters and their control.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PO12	PO12
CO 1	3	2	2	3		1	1					1	3	2
CO 2	3	2	3	3		2	1					1	3	3
CO 3	2	1	1	1		1	1					1	3	2
CO 4	3												3	3
CO 5	3												3	3
AVG	2.6	1.6	2	2.3		1.3	1					1	3	2.6

CONTROL SYSTEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0215	PROFESSIONAL CORE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0	Practical Classes: 0			Total Classes: 48			

OBJECTIVES:

To make the students learn about:

- Merits and demerits of open loop and closed loop systems; the effects of feedback.
- The use of block diagram algebra and Mason's gain formula to find the effective transfer function between two nodes.
- Transient and steady state responses, time domain specifications.
- The concept of Root loci.
- Frequency domain specifications and Bode diagrams.
- The fundamental aspects of modern control Systems.

UNIT-I	INTRODUCTION AND MODELING OF PHYSICAL SYSTEMS	Classes: 10

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, Block diagram reduction methods – Signal flow graph - Reduction using Mason's gain formula. Transfer Function of DC Servo motor - AC Servo motor - Synchro transmitter and Receiver.

UNIT - II	TIME RESPONSE ANALYSIS	Classes: 10

Standard test signals -Step Response – Ramp and 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 - effects of proportional, derivative, integral and integral, proportional derivative, proportional integral and PID controllers.

UNIT - III	CONCEPT OF STABILITY AND ROOT LOCUS TECHNIQUE	Classes: 9

The concept of stability – Necessary and sufficient conditions for stability - Stability and conditional stability - Routh's stability criterion — limitations of Routh's stability.

The root locus concept - Introduction, root locus concept, construction of root loci-graphical determination of 'k' for specified damping ratio, relative stability - effects of adding poles and zeros to G(s)H(s) on the root loci.

UNIT - IV	FREQUENCY RESPONSE ANALYSIS	Classes: 9

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- Phase margin and Gain Margin-Stability Analysis.

Compensation techniques – Lag, Lead, Lag-Lead Compensator design in frequency Domain.

UNIT - V	STATE SPACE ANALYSIS	Classes: 10

Concepts of state, state variables and state model, derivation of state models from differential equations. Transfer function models. Block diagrams. Diagonalization. Solving the Time invariant state Equations- State Transition Matrix and it's Properties. System response through State Space models. The concepts of controllability and observability.

Text Books:

1. Modern Control Engineering, Katsuhiko Ogata, PEARSON, 1st Impression 2015.
2. Control Systems Engineering, I. J. Nagrath and M. Gopal, New Age International Publishers, 5th edition, 2007, Reprint 2012.

Reference Books:

1. Automatic Control Systems, Farid Golnaraghi and Benjamin. C. Kuo, WILEY, 9th Edition, 2010.
2. Control Systems, Dhanesh N. Manik, CENGAGE Learning, 2012.
3. John J D'Azzo and C. H. Houpis , "Linear Control System Analysis and Design: Conventional and Modern", McGraw - Hill Book Company, 1988.

Course Outcome:

After completing the course, the student should be able to

1. Understand the concept of open and closed loop control systems, transfer function of block diagrams and signal flow graph techniques.
2. Calculate time domain specifications.
3. Determine stability using RH criterion and Root locus.
4. Determine frequency response of control systems.

5. Analyze state space analysis, concept of controllability and observability

CO-PO MAPPING

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 1
CO1	3	3	3	2									3	3
CO2	2	1	2	2									2	2
CO3	2	2	2	2									3	3
CO4	2	2	2	3									3	3
CO5	3	3	3	2									3	3
AVG	2.4	2.2	2.4	2.2										

POWER QUALITY

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0201	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

I. Understand the terminology used to describe power quality.
II. The sources of power quality disturbances and power transients that occur in power systems.
III. The sources of harmonics, harmonic indices, Devices for controlling harmonic distortion.
IV. The principle of operation of DVR and UPQC.

UNIT-I	INTRODUCTION	Classes:10

Introduction of the power quality (PQ) problem, terms used in PQ: Voltage, sag, swell, surges, harmonics, over voltages, spikes, voltage fluctuations, transients, interruption, overview of power quality phenomenon, remedies to improve power quality, power quality monitoring.

UNIT - II	TRANSIENTS, SHORT DURATION AND LONG DURATION VARIATIONS	Classes:10

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.

UNIT - III	FUNDAMENTALS OF HARMONICS & APPLIED HARMONICS	Classes:9
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.		
UNIT - IV	**POWER QUALITY MONITORING**	**Classes:9**
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.		
UNIT - V	**POWER QUALITY ENHANCEMENT USING CUSTOM POWER DEVICES**	**Classes:10**
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.		

Text Books:

1. 1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition, 2012.
2. Power quality, C. Sankaran, CRC Press, 2001.

Reference Books:

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

Web References:

1. https://www.researchgate.net
2. https://www.aar.faculty.asu.edu/classes
3. https://www.facstaff.bucknell.edu/
4. https://www.electrical4u.com
5. https://www.crectirupati.com

E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com

Course Outcome:

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

- Address power quality issues to ensure meeting of standards
- Apply the concepts of compensation for sags and swells using voltage regulating devices
- Gain a comprehensive understanding of harmonics and applied harmonics, demonstrating the ability to analyze, mitigate, and address harmonic distortions in electrical systems for improved power quality .
- Attain proficiency in power quality monitoring, showcasing the ability to analyze and assess electrical systems, identify power disturbances, and implement solutions to ensure reliable and efficient power delivery.
- Acquire expertise in power quality enhancement using custom devices, demonstrating the ability to design, implement, and optimize custom solutions to mitigate power quality issues, ensuring a more reliable and stable electrical system.

CO-PO MAPPING

POs related to COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2		3								1	2	3
CO 2	3	2	3	3								1	2	3
CO 3	3	2	3	3								1	3	3
CO 4	3	2	3	3								1	2	3
C0 5	3		3	3								1	3	3
AVG	3	1.6	2.4	3								1	2.4	3

ELECTRICAL DISTRIBUTION SYSTEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0202	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes:0	Practical Classes: 0			Total Classes: 48			

OBJECTIVES:

The course should enable the students :

To study different factors of Distribution system.
To study and design the substations and distribution systems.
To study the concepts of voltage drop and power loss.
To study the distribution system protection and its coordination.
To study the effect of compensation for power factor improvement.
To study the effect of voltage control on distribution system.

UNIT-I	GENERAL CONCEPTS	Classes:10

Introduction to distribution systems – Distribution system losses – Coincidence factor – Contribution factor loss factor – Numerical Problems – Load Modelling and Characteristics – Relationship between the load factor and loss factor – Classification and characteristics of loads (Residential, commercial, Agricultural and Industrial).

UNIT - II	SUBSTATIONS	Classes:10

Location of substations: Rating of distribution substation – Service area with 'n' primary feeders – Benefits and methods of optimal location of substations..

Distribution Feeders

Design Considerations of distribution feeders: Radial and loop types of primary feeders – Voltage levels – Feeder loading – Basic design practice of the secondary distribution system.

UNIT - III	SYSTEM ANALYSIS	Classes:9

Voltage drop and power–loss calculations: Derivation for voltage drop and power loss in lines – Uniformly distributed loads and non-uniformly distributed loads – Numerical

problems – Three phase balanced primary lines.

UNIT - IV	PROTECTION, COORDINATION & AUTOMATION	Classes:9

Objectives of distribution system protection –Time current characteristics – Protective devices: Principle of operation of fuses – Circuit Reclosures – Line sectionalizes and circuit breakers, Modulated case circuit breakers, Earth leakage circuit breakers – Protection schemes of parallel & Ringmain feeders.

Coordination of protective devices: General coordination procedure –Various types of co-ordinated operation of protective devices – Residual Current Circuit Breaker Automation: Block diagram approach of SCADA.

UNIT - V	COMPENSATION FOR POWER FACTOR IMPROVEMENT	Classes:10

Capacitive compensation for power factor control – Different types of power capacitors – shunt and series capacitors – Effect of shunt capacitors (Fixed and switched) – Power factor correction – Capacitor allocation – Economic justification – Procedure to determine the best capacitor location – Numerical problems.

Voltage Control

Voltage Control: Equipment for voltage control – Effect of series capacitors – Effect of AVB/AVR – Line drop compensation – Numerical problems.

Text Books:

1. Electric Power Distribution system, Engineering" – by Turan Gonen, McGraw–hill Book Company.

Reference Books:

1. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo, CRC press
2. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing company, 4th edition, 1997.
3. Electrical Power Distribution Systems by V.Kamaraju, Right Publishers

Course Outcome:

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

1. Understand various factors and characteristics of distribution system
2. Understand, analyse and design of various types of substations, feeders and selection of its location.
3. Analyse the power system by calculating the voltage drops and power losses at all buses.
4. Understand and analyse the powers system protection, coordination and automation.
5. Understand the effect of compensation for p.f improvement and analysing the effect of voltage control.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	POS1	PSO2
CO1	3	3	3	2								1	2	3
CO2	3	3	2	2								1	3	3
CO3	3	3	1	1								1	3	3
CO4	3	3	3	2									2	3
CO5	3	3	2	2									2	3
	3	3	2.2	1.8								1	2.4	3

PROGRAMABLE LOGIC CONTROLLER

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0203	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0	Practical Classes: 48			Total Classes: 48			

Course Objectives:

1.To explain the operation of relays, pushbuttons, limit switches, and other basic control devices using ladder diagrams, design basic motor control circuits.
2.Describe the hardware of a PLC, identifying the functions of the main components.
3.To explain the PLC programs to perform specified discrete sequential control operations.
4.Configure a PLC, including choosing appropriate addressing for I/O for a specified application

UNIT – I	INTRODUCTION	Classes:10

Programmable controller –need for PLC –modular PLC and fixed PLC –Blockdiagram of PLC –input and output modules –power supply –types of PLC system.

UNIT – II	HARDWARE MODULES	Classes:10

CPU –processor‟s function –processor‟s operating system –processor ports –interfacing PC to PLC –processor operating modes –PLC system memory andapplication memory –input modules –output modules –module selection –PLC internal operation and signal processing –input and output processing–timing consideration.

UNIT – III	PLC PROGRAMMING	Classes:9

Introduction to IEC 61131 -System functions –sequence control –ladder logic –programming sequences –limitation of ladder programming –logic instruction sets –standard PLC functions –special functionrelays –data handling instructions –arithmetic instructions –data manipulation –program subroutines –programming examples

UNIT – IV	INTERFACES IN DCS	Classes:9

PLC communication ports –serial communications –RS232 –standard requirements –communication between several PLCs –PLC field bus -ManufacturingAutomation

Protocol (MAP) –Technical Office Protocol (TOP) -Distributed controlsystem (DCS) – building blocks –descriptions and functions of field-controlled units –operator stations – data highways –redundancy concepts –DCS system integration with PLC and computers –communication in DCS.

UNIT – V	**PLC MAINTENANCE AND CASE STUDIES**	**Classes:10**

PLC maintenance –internal PLC faults –faults external to PLC –programmed error – watch dogs –safety –hardware safety circuits –troubleshooting. Case Studies: PLC as robot controller and FMS –
PLC to factory automation –PLC in process control

Text Books:

1) Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson, 2nd Edition
2) John R. Hackworth, Frederick D., Hackworth Jr., "Programmable Logic Controllers Programming Methods and Applications"
3) John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Application", 5th edition.

Reference Books:

1.Frank D. Petruzella, "Programmable Logic Controllers", McGraw-Hill Companies, 3rdEdition, March 2013.
2. Lukcas M.P., "Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986
3. Ian G.Warnock, "Programmable Controllers Operation and Application", Prentice Hall International, UK, 1992.
4. John W. Webb and Ronald A.Reis, "Programmable Logic Controllers – Principles and Applications", Prentice Hall Inc., New Jersey, 3rdEdition, 1995.
5. Krishnakant , "Computer Based Industrial Control", Prentice Hall of India, 1997.
6. https://docshare.tips/plc-syllabus-docx_588a4d16b6d87fcb698b4c8b.html

Course Outcome:

After successful completion of this course, the students should be able to
1.Explain and use relays, pushbuttons, limit switches, and other basic control devices for automation.
2.Describe the hardware and architecture of PLCs and also identify the analogy of relay logic components.
3.Write PLC programes using ladder diagrams for complex applications.
4. Develop proficiency in designing and implementing interfaces in Distributed Control Systems (DCS) for Programmable Logic Controller (PLC) systems
5. Attain mastery in PLC maintenance and troubleshooting through real-world case studies, showcasing the ability to diagnose, repair, and optimize Programmable Logic Controller (PLC) systems.

CO-PO MAPPING

Pos related to Cos	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1			1					1	**1**	**2**
CO2	3	1	1	1			1					1	**2**	**2**
CO3	3	2	2	2	3							1	**2**	**2**
CO4	3	1	1	1								1	**2**	**3**
CO5	3	2	1	1	3							1	**1**	**2**
AV G	3	1.4	1. 4	1.2	3		1					1	**1.6**	**2.2**

SIGNALS AND SYSTEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0403	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0	Practical Classes: 48			Total Classes: 48			

OBJECTIVES:

- Analyze the discrete time signals and system using different transform domain techniques.
- Design and implement LTI filters for filtering different real world signals.
- Develop different signal processing applications using DSP processor.
- To study about signals and systems.
- To understand the stability of systems through the concept of ROC.

UNIT – I	INTRODUCTION	Classes:10

Introduction to Signals and Systems Signals and systems as seen in everyday life, and in various branches of engineering and science. Continuous time signals (CT signals)- Discrete time signals (DT signals) – Step, Ramp, Pulse, Impulse, Exponential - classification of CT and DT signals – periodic and aperiodic signals, random signals, deterministic signals, Energy ,Power signals - CT systems and DT systems.
Classification of systems System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability

UNIT – II	BEHAVIOR OF CONTINUOUS AND DISCRETE-TIME SIGNALS	Classes:10

Behavior of continuous and Discrete-time LTI systems Differential Equation-Block diagram representation-impulse response, convolution integrals-Fourier and Laplace transforms in Analysis. Impulse response and step response, convolution, input-output behavior with a periodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems.

UNIT – III	CONTINUOUS & DISCRETE FOURIER	Classes:9

	TRANSFORMS	
Continuous & Discrete Fourier Transforms: Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, Properties & Signal representation. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.		
UNIT – IV	**LAPLACE AND Z- TRANSFORMS**	**Classes:9**
Laplace and Z- Transforms Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros ofsystem functions and signals. Reviewof the z-Transform for discretetime signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis		
UNIT – V	**SAMPLING AND RECONSTRUCTION**	**Classes:10**
Sampling and Reconstruction The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems		
Text Books:		
1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems",Prentice Hall India,1997. 2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and applications", Pearson, 2006. 3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education,2010. 4. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.		
Reference Books:		
1. A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing",Prentice Hall, 2009. 6. 2.M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education,2007		
Course Outcome: After successful completion of this course, the students should be able to • Have basic knowledge on signals and systems (both continuous time and discrete time) and their properties. • Able to understand the behaviour of continuous and discrete time LTI systems, Fourier Transform and Laplace Transform • Able to Represent continuous and discrete systems in time and frequency domain using different transforms and their properties • Apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems. • Able to understand the sampling theorem and its implications		

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	2	2	2	-	-	-	-	-	2	2	1
CO 2	3	3	2	2	1	2	-	-	-	-	2	3	2	2
CO 3	3	3	2	3	2	2	-	-	-	3	2	3	2	2
CO 4	3	2	2	2	2	2	2	-	-	3	-	3	2	2
CO 5	3	3	3	2	2	1	3	-	-	-	2	3	2	2
	3	2.6	2	2. 2	1.8	1.8	2.5	-	-	3	2	2.8	2	1.8

CONTROL SYSTEMS AND SIMULATION LAB

Course Code	Category	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0216	PROFESSIONAL CORE	-	-	3	1.5	40	60	100
Contact Classes: 0	Tutorial Classes: 0	Practical Classes: 48			Total Classes: 48			

OBJECTIVES:

The course should enable the students to:

I. Understand mathematical models of electrical and mechanical systems.
II. Analysis of control system stability using digital simulation.
III. Demonstrate the time domain and frequency domain analysis for linear time invariant systems.
IV. Apply programmable logic controllers to demonstrate industrial controls in the laboratory.

LIST OF EXPERIMENTS

Expt. 1	**TIME RESPONSE OF SECOND ORDER SYSTEM**
To obtain the time response of a given second order system with time domain specifications.	
Expt. 2	**TRANSFER FUNCTION OF DC MOTOR**
Determine the transfer function, time response of DC Motor and verification using digital simulation.	
Expt. 3	**DC AND AC SERVO MOTOR**
Study DC and AC servomotor and plot its torque speed characteristics	
Expt. 4	**EFFECT OF VARIOUS CONTROLLERS ON SECOND ORDER SYSTEM**
Study the effect of P, PD, PI and PID controller on closed loop second order systems.	
Expt. 5	**COMPENSATOR**
Study Lead-Lag compensator and obtain its magnitude, phase plots.	

Expt. 6	**TEMPERATURE CONTROLLER**
Study the performance of PID controller used to control the temperature of an oven.	
Expt. 7	**DESIGN AND VERIFICATION OF OP-AMP BASED PID CONTROLLER**
Implementation of PID controller using Op-Amps and verification using MATLAB.	
Expt. 8	**STABILITY ANALYSIS USING DIGITAL SIMULATION**
Stability analysis using root locus, Bode plot, Polar, Nyquist criterions of linear time invariant system by digital simulation.	
Expt. 9	**STATE SPACE MODEL USING DIGITAL SIMULATION**
Verification of state space model for transfer function and transfer function from state space modelusing digital simulation	
Expt. 10	**LADDER DIAGRAMS USING PLC**
Input output connection, simple programming, ladder diagrams, uploading, running the program and debugging in Programmable logic controller.	
Expt. 11	**TRUTH TABLES USING PLC**
Study and verification of truth tables of logic gates, simple Boolean expressions and application to speed control of DC motor using Programmable logic controller.	
Expt. 12	**IMPLEMENTATION OF DIRECT ONLINE STARTER USING PLC**
Implementation of direct online starter using Programmable logic controller.	
Expt. 13	**BLINKING LIGHTS USING PLC**
Implementation of blinking lights with Programmable logic controller.	
Expt. 14	**SPEED CONTROL OF DC MOTOR USING PLC**
Starting and speed control of DC motor using Programmable logic controller.	
Expt. 15	**LINEAR SYSTEM ANALYSIS**
Linear System Analysis (Time Domain Analysis, Error Analysis) Using MATLAB.	
Reference Books:	
1. J Nagrath, M Gopal, "Control Systems Engineering", New Age International, 3rd Edition, 2007. 2. K Ogata, "Modern Control Engineering", Prentice Hall, 4th Edition, 2003. 3. Benjamin Kuo, "Automatic Control Systems", PHI, 7th Edition, 1987.	
SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 36 STUDENTS:	

SOFTWARE: MATLAB Software **HARDWARE:** Desktop Computers (04 nos)

Course Outcome:

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

1. Understand mathematical models of electrical and mechanical systems.
2. Analysis of control system stability using digital simulation.
3. understand the performance of basic control system components such as D.C. servo motors, A.C. Servo motors, stepper motor.
4. To understand time and frequency responses of control system with and without controllers and compensators.
5. Acquire hands-on proficiency in Programmable Logic Controller (PLC) programming and troubleshooting.
6. Follow the ethical principles in implementation of experiments
7. Do Experiments effectively as individual and as team member in a group.
8. Communicate verbally and in written form, understanding about the experiments.
9. Continue Updating the skills related to contemporary technology

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1				3	1		1	2	2
CO2	3	2	2	2	3				3	1		1	2	1
CO3	3	1	1	2	1				3	1		1	2	1
CO4	3	1	2	2	2				3	1		1	2	2
CO5	3	2	2	2	1				3	1		1	1	1
CO6								3						
CO7									3					
CO8										3				
CO9												3		
AVG	3	1.6	1.8	2	1.6			3	3	1.3		1.3	1.8	1.4

POWER ELECTRONICS AND SIMULATION LABORATORY

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0217	PROFESSIONAL CORE	-	-	3	1.5	40	60	100
Contact Classes: 0	Tutorial Classes: 0	Practical Classes: 48			Total Classes: 48			

OBJECTIVES:

The course should enable the students to:

I. Examine the characteristics of various devices and application of firing circuits used in power electronics.
II. Outline the performance characteristics of AC voltage regulators, choppers, inverters, rectifiers and cycloconverters.
III. Demonstrate the working principle of various power electronic devices and circuits using simulation.
IV. Design the circuit of switched mode power supplies through simulation.

LIST OF EXPERIMENTS

Expt. 1	**SCR, MOSFET AND IGBT**
Study the characteristics of SCR, MOSFET and IGBT.	
Expt. 2	**GATE FIRING CIRCUITS**
Gate firing circuits of SCR.	
Expt. 3	**HALF CONTROLLED CONVERTER**
Single phase half controlled converter with R and RL loads.	
Expt. 4	**FORCED COMMUTATION CIRCUITS**
Forced commutation circuits (Class A, Class B, Class C, Class D and Class E).	

Expt. 5	**FULLY CONTROLLED BRIDGE CONVERTER**
Single phase fully controlled bridge converter with R and RL loads.	
Expt. 6	**SERIES INVERTER**
Single phase series inverter with different loads.	
Expt. 7	**PARALLEL INVERTER**
Single phase parallel inverter with different loads.	
Expt. 8	**VOLTAGE CONTROLLER**
Single phase AC voltage controller with R and RL loads.	
Expt. 9	**DUAL CONVERTER**
Single phase dual converter with R and RL loads.	
Expt. 10	**CYCLOCONVERTER**
Single phase cycloconverters with R and RL loads.	
Expt. 11	**THREE PHASE CONVERTERS**
Three phase half converter with R and RL loads.	
Expt. 12	**MOSFET BASED CHOPPERS**
Operation of step down chopper using MOSFET.	
Expt. 13	**SIMULATION OF THREE PHASE FULL CONVERTER AND PWM INVERTER**
Simulation of three phase full converter and PWM inverter with R and RL loads by using MATLAB.	
Expt. 14	**SIMULATION OF BUCK – BOOST CHOPPER**
Simulation of boost, buck, buck boost converter with R and RL loads by using MATLAB.	
Reference Books:	

1. M H Rashid, “Power Electronics, Circuits, Devices and Applications”, Pearson, 3rd Edition, 2001.
2. M D Singh, K B Kanchandhani, “Power Electronics”, Tata McGraw Hill Publishing Company, 7th Edition, 2007.
3. Dr. P S Bimbhra, “Power Electronics”, Khanna Publishers, 5th Edition, 2012.

Web References:

1. https://www.ee.iitkgp.ac.in
2. https://www.citchennai.edu.in
3. https://www.crectirupati.com

Course Outcome:

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

1. Test the turn on –turn off characteristics of various power electronic devices.
2. Test and analyze firing circuits for SCRs
3. Test different types of voltage controllers, converters and Inverters with R and RL loads
4. GYR
5. FJT
6. Follow the ethical principles in implementation of experiments
7. Do Experiments effectively as individual and as team member in a group.
8. Communicate verbally and in written form, understanding about the experiments.
9. Continue Updating the skills related to contemporary technology

CO-PO MAPPING

	PO 1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1				3	1		1	2	1
CO2	3	2	2	2	3				3	1		1	2	1
CO3	3	1	1	2	1				3	1		1	2	1
CO4	3	1	2	2	2				3	1		1		
CO5	3	2	2	2	1				3	1		1		
CO6								3						
CO7									3					
CO8										3				
CO9												3		
AVG	3	1.6	1.8	2	1.6			3	3	1.3		1.3	2	1

SEMESTER VI

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0218	PROFESSIONAL CORE	3	-	-	3	40	60	100
Contact Classes:48	Tutorial Classes: 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

I. Demonstrate the principle, working of electrical measurement instruments.
II. Illustrate the principles of energy measurement in electrical loads.
III. Outline the use of cathode ray oscilloscope.
IV. Evaluate various transducers for electrical measurements.

UNIT - I	INTRODUCTION TO ANALOG MEASURING INSTRUMENTS	Classes:10

Classification – Ammeters and Voltmeters – PMMC, Dynamometer, Moving Iron Type Instruments Single Phase Dynamometer Wattmeter Double Element and Three Element Dynamometer Wattmeter. Single Phase Induction Type Energy Meter . Three Phase Energy Meter. (Principle and working only)

UNIT - II	INTRODUCTION TO DIGITAL MEASURING INSTRUMENTS	Classes:10

Current Transformers and Potential Transformers Ratio and Phase Angle Errors. Potentiometers: Principle and Operation of D.C. Crompton's Potentiometer

Introduction to digital Measurements Digital Voltmeters - Successive Approximation, Ramp and Integrating Type-Digital Frequency Meter-Digital Multi meter-Digital Tachometer

UNIT -III	OSCILLOSCOPES AND BRIDGES	Classes: 9

Oscilloscopes: CRO, CRT features, derivation of deflection sensitivity Measurement of amplitude, frequency and phase (Lissajous method).

DC Bridges: Wheatstone bridge, Wein Bridge Kelvin Bridge, AC bridges: Measurement of inductance-Maxwell's bridge, Anderson Bridge. Measurement of capacitance-SchearingBridge .Measurement of low medium high resistance methods

UNIT - IV	INTRODUCTION TO TRANSDUCERS	Classes:10
Definition of Transducers. Principle of Operation of Resistive, Inductive, Capacitive Transducers, LVDT, Strain Gauge and Its Principle of Operation, Gauge Factor, Thermistors, Thermocouples, piezoelectric Transducers, Photovoltaic, Photo Conductive Cells, Photo Diodes Measurement of Displacement, Velocity, Angular Velocity, Acceleration, Force, Torque, Temperature, Pressure, Flow, Liquid level.(any two methods)		
UNIT - V	**INDUSTRIAL ENERGY MEASUREMENT METHODS**	**Classes: 9**
Static /microprocessor based Energy meter,multi function meters, Industrial energy measurement methods-low voltage high current, high voltage high current . Concept of Theft of energy detection -Energy consumption when voltage coil reversed, current coil reversed. Energy consumption when CT ratio changes.		

Text Books:

1. A K Sawhney, "Electrical and Electronic measurement and instruments", DhanpatRai and Sons Publications.
2. E W Golding and F C Widdis, "Electrical measurements and measuring instruments" wheeler publishing. 5th Edition.
3. J.B. Gupta "A Course in Electrical and Electronic Measurements & Instrumentation" SK Kataria and Son's, 14th Edition

Reference Books:

1. Buckingham and Price, "Electrical measurements", Prentice Hall.
2. D V S Murthy, "Transducers and Instrumentation", Prentice Hall of India, 2nd Edition, 2009.
3. A S Morris, "Principles of measurement of instrumentation", Pearson/Prentice Hall of India, 2nd Edition, 1994.
4. H S Kalsi, "Electronic Instrumentation", Tata McGrawHill Edition, 1st Edition 1995.

Course Outcomes:

At the end of the course a student will be able to:

1. Explain the working of various analog measuring instruments.
2. Discuss various errors in measuring digital instruments.
3. Explain CROs and measurement of unknown parameters using bridges
4. Discuss various types of Transducers
5. Select the suitable energy measurement methods for industrial loads .

CO-PO MAPPING

	PO1	PO2	PO 3	PO4	PO5	PO 6	PO7	PO8	PO 9	PO10	PO1 1	PO12	PSO1	PSO2
CO1	3	1		1								1	2	1
CO2	3	2	1	2								1	2	1
CO3	3	1	1	1								1	2	1
CO4	3											1	2	1
CO5	3	2	2	2								1	2	1
AV G	3	1.2	0.8	1.2								1	2	1

POWER SYSTEM ANALYSIS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0219	PROFESSIONAL CORE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

I. Illustrate the formation of [Z] bus of a power system network.
II. Compute power flow studies by various numerical methods.
III. Discuss the symmetrical component theory, sequence networks and short circuit calculations.
IV. Analyze power system for steady state stability
V. Analyze power system for Transient stability and suggest methods to improve.

UNIT - I	POWER SYSTEM NETWORK MATRICES	Classes: 10

Graph Theory: Fundamental Concepts and Definition, Development of bus incidence matrices.

Network Matrices: Formation **of** Y bus by singular transformation and direct inspection methods, numerical problems; Formation of Z Bus: Partial network, algorithm for the modification of Z bus matrix for addition of element from a new bus to reference bus, addition of element from a new bus to an old bus, addition of element between an old bus to reference bus and addition of element between two old busses (Derivations and Numerical Problems), modification of Z bus for the changes in network elements(Numerical Problems).

UNIT - II	POWER FLOW STUDIES AND LOAD FLOWS	Classes: 10

Load flows studies: Necessity of power flow studies, data for power flow studies, derivation of static load flow equations; Load flow solutions using Gauss Seidel method: Acceleration factor, load flow solution with and without PV buses, algorithm and flowchart; Numerical load flow solution for simple power systems (Max. 3 buses): Determination of bus voltages, injected active and reactive powers (Sample one iteration only) and finding line flows / losses for the given bus voltages; Newton Raphson method in rectangular and polar coordinates form: Load flow solution with

or without PV busses derivation of Jacobian elements, algorithm and flowchart, decoupled and fast decoupled methods, comparison of different methods, DC loads flow.		
UNIT - III	**SHORT CIRCUIT ANALYSIS PER UNIT SYSTEM OF REPRESENTATION**	**Classes: 10**
Per unit system: Equivalent reactance network of a three phase power system, numerical problems; Symmetrical fault analysis: Short circuit current and MVA calculations, fault levels, application of series reactors, numerical problems; Symmetrical component theory: Symmetrical component transformation, positive, negative and zero sequence components, voltages, currents and impedances. **Sequence networks**: Positive, negative and zero sequence networks, numerical problems; Unsymmetrical fault analysis: LG, LL, LLG faults with and without fault impedance, numerical problems.		
UNIT - IV	**STEADY STATE STABILITY ANALYSIS**	**Classes: 9**
Steady state stability: Elementary concepts of steady state, dynamic and transient stabilities, description of steady state stability power limit, transfer reactance, synchronizing power coefficient, power angle curve and determination of steady state stability and methods to improve steady state stability.		
UNIT - V	**TRANSIENT STATE STABILITY ANALYSIS**	**Classes: 9**
Swing equation: Derivation of swing equation, determination of transient stability by equal area criterion, application of equal area criterion, critical clearing angle calculation, solution of swing equation, point by point method, methods to improve stability, application of auto reclosing and fast operating circuit breakers.		
Text Books:		
1. I J Nagrath& D P Kothari, "Modern Power system Analysis", Tata McGraw-Hill Publishing Company, 2nd Edition. 2. C L Wadhwa, "Electrical Power Systems", Newage International, 3rd Edition. 3. M A Pai,"Computer Techniques in Power System Analysis", TMH Publications. 4. N..Ramana "Power System Analysis",Pearson Education India.		
Reference Books:		
1. K Umarao, "Computer techniques and models in power systems", I K International Pvt. Ltd. 2. HadiSaadat, "Power System Analysis", 2nd *Edition*, *TMH*. *Edition*, 2003. 3. Grainger and Stevenson, "Power System Analysis", Tata McGraw Hill. 4. J Duncan Glover and M S Sarma., THOMPSON, "Power System Analysis and Design", 3rd Edition. 5. Abhijit Chakrabarthi and SunitaHaldar, "Power system Analysis Operation and control", 3rd Edition, PHI, 2010.		

Web References:

1. https://www.worldcat.org/title/computer-methods-in-power-system-analysis/.../600788826
2. https://www.sjbit.edu.in/.../COMPUTER%20%20TECHNIQUES%20IN%20POWER%20%20SYS..
3. https://www.books.google.com › Technology & Engineering › Electrical
4. https://www. nptel.ac.in/courses/108105067/
5. https://www.jntusyllabus.blogspot.com/2012/01/computer-methods-power-systems-syllabus.html

E-Text Books:

1. https://www.scribd.com/.../Computer-Methods-in-Power-System-Analysis-by-G-W-St...
2. https://www.academia.edu/8352160/Computer_Methods_and_Power_System_Analysis_Stagg
3. https://www.uploady.com/#!/download/ddC9obmVTiv/NwO1AnQrlmogeJjS
4. https://www.materialdownload.in/article/Computer-Methods-in-Power-System-Analysis_159/
5. https://www.ee.iitm.ac.in/2015/07/ee5253/

Course Outcome:

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

1. Find [Z] bus and [Y] bus of a power system network
2. Analyze load flow studies(different algorithms, flow charts)
3. Analyze the symmetrical and unsymmetrical components, sequence networks, unsymmetrical fault analysis
4. Analyze steady state stability of power system
5. Analyze transient stability of power system

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	2	2	2		2					1	2	2
CO 2	3	3	3	3	2		2					1	2	2
CO 3	3	3	2	3	2		3					1	2	2
CO 4	3	3	2	3	2		2					1	2	2
CO 5	3	3	2	3	3		2					1	2	2
AVG	3	3	2.2	2.8	2.2		2.2					1	2	2

MICROPROCESSORS AND MICROCONTROLLERS

Course Code	Category	Hours / Week			Credits	Maximum		
		L	T	P	C	CIA	SEE	Total
20PC0414	PROFESSIONAL CORE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0	Practical Classes: 0				Total Classes:48		

OBJECTIVES:

1. To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
2. To familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
3. To provide strong foundation for designing real world applications using microprocessors and microcontrollers.

UNIT-I	INTRODUCTION	Classes: 10

8086 Architecture-Block Diagram, Pin Diagram, Register Organization, Flag Register, Timing Diagrams, Memory Segmentation, Interrupt structure of 8086.

UNIT-II	INSTRUCTION SET & PROGRAMMING	Classes: 10

Addressing Modes-Instruction Set of 8086, Assembler Directives- Macros and Procedures-Simple ALPs.

UNIT-III	LOW POWER RISC MSP430	Classes: 9

Block diagram, features and architecture, Variants of the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x and their targeted applications, Register sets Addressing modes, Instruction set, on-chip peripherals (analog and digital), Sample Embedded system on MSP430 microcontroller

UNIT-IV	I/O PORTS	Classes: 10

Pull up/down resistors concepts, Interrupts, Watchdog Timer, System clocks, Low Power aspects of MSP430: Low power modes, Active Vs Standby current consumption, FRAM Vs Flash, Basic Timers, Real Time Clock (RTC), PWM control, Data transfer using DMA

UNIT-V	SERIAL COMMUNICATION	Classes: 10

Serial communication basics, Synchronous/Asynchronous interfaces - UART, USB, SPI, and I2C.ImplementingandprogrammingUART,I2C,SPI interfaces using MSP430, Implementing Embedded Wi-Fi using CC3100

Text Books:

1. A.K.Ray&K.M. Bhurchandi "Advanced Microprocessors and Peripherals", 2nd Edition TMH 2012.
2. MSP430 microcontroller basics,John H. Davies, Newnes Publication, 1st Edition,2008.

Reference Books:

1. The X86 Microprocessors,Architecture,Programming and Interfacing, Lyla B. Das, Pearson Publications,2010
2. http://processors.wiki.ti.com/index.php/MSP430_LaunchPad_Low_Power_Mode
3. http://processors.wiki.ti.com/index.php/MSP430_16-Bit_Ultra-Low_Power_MCU_Training

Course Outcomes: The students can able to

1. Assess and solve basic binary math operations using the microprocessor and explain the microprocessor's and Microcontroller's internal architecture and its operation within the area of manufacturing and performance.
2. Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller.
3. Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.
4. Design and implement specific real time applications
5. Evaluate assembly language programs and download the machine code that will provide solutions real world control problems.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	2								1	2	1
CO 2	2	2	1	3								1	2	1
CO 3	3			3								1	2	1
CO 4	3	1		3								1	2	2
CO 5	3	2	2	3								1	2	2
AVG	2.8	1.4	1.2	2.8								1	2	1.4

MODERN CONTROL THEORY

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0204	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: - 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

I. Concept of State Variable analysis and design
II. Analyze Solution of State equations
III. Tests for controllability and observability.
IV. Analyze stability in the sense of Lyapunov
V. Design of Phase plane analysis.

UNIT-I	STATE VARIABLE ANALYSIS AND DESIGN	Classes:9

Introduction, definitions, State space formulation, State model, Derivation of transfer function from a state model, Derivation of state model from transfer function, State diagram representation, state diagram of standard state model, State model of electrical systems.

UNIT - II	SOLUTION OF STATE EQUATIONS	Classes:10

Introduction, Solution of non-homogeneous state equation, State transition matrix and its properties, Evaluation of state transition matrix by -Power series method, Inverse Laplace transforms method, Cayley Hamilton theorem.

UNIT - III	CONTROLABILITY AND OBSERVABILITY	Classes:10

Concept of controllability and observability, Methods of testing the state equations, Principle of Duality, Problems.

UNIT - IV	LYAPOUNOV'S STABILITY ANALYSIS	Classes:10

Stability in the sense of Lyapunov's. Lyapunov's stability and Lyapunov's instability theorems. Direct method of Lyapunov's for the linear and Nonlinear continuous time autonomous system.

UNIT - V	PHASE PLANE ANALYSIS	Classes:9

Introduction, methods of analysis-phase plane analysis, Singular points, Construction of phase trajectories, Numerical problems

Text Books:

1. M Gopal, "Modern Control System Theory", New Age International Publishers,

Revised2nd Edition, 2005.
2. K Ogata, "Modern Control Engineering", Prentice Hall, 5th Edition, 2010.
3. N C Jagan, "Control Systems", BS Publications, 1st Edition, 2007.

Reference Books:

1. J Nagrath, M Gopal, "Control Systems Engineering", New Age International Publications, 4th Edition.
2. DRoy Choudhury, "Modern Control Engineering", PHI Learning private Limited, 2015
3. Anand Kumar, "Control Systems", PHI Learning, 1st Edition, 2007.
4. S Palani, "Control Systems Engineering", Tata McGraw Hill Publications, 1st Edition, 2001.
5. N K Sinha, "Control Systems", New Age International Publishers, 1st Edition, 2002.

Web References:

1. https://www.researchgate.net
2. https://www.aar.faculty.asu.edu/classes
3. https://www.facstaff.bucknell.edu/
4. https://www.electrical4u.com
5. https://www.crectirupati.com

E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com

Course Outcomes:

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

- Able to design a state diagram of a state model
- Able to find the solutions of a state equation
- Able to test whether a given system is controllable and/or observable
- Understand the Lyapunov criterion and determine stability of a given system
- Understand the Phase plane analysis

CO- PO MAPPING

s (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	2	2	2		2						1	
CO 2	3	1	2	2	2		2					1	1	
CO 3	3	1	2	1	2		2					2	1	
CO 4	3	1	2	2	2		2					2	1	
CO 5	3	1	2	2	3		2						1	
AVG	3	1	2	1.8	2.2		2					1	1	

INDUSTRIAL AUTOMATION AND CONTROL

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0205	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes:0		Practical Classes: 48			Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

I. Learn the fundamental concepts about introduction to industrial automation and control and devices.
II. Study the performance of each system in detail along with practical case studies.
III. Develop various types of industrial automation and control and devices.
IV. Understand the process control of PLC automation.

UNIT-I	INTRODUCTION TO INDUSTRIAL AUTOMATION AND CONTROL	Classes:10

Introduction to Industrial Automation and Control: Introduction to industrial automation and control architecture of industrial automation system, measurement systems specifications, temperature measurement, pressure and force measurement, displacement and speed measurement, signal conditioning circuits, errors and calibration.

UNIT - II	PROCESS CONTROL	Classes: 10

Process control: Introduction to process control, PID control, controller tuning, implementation of PID controllers, special control structures, feed forward and ratio control special control structures: predictive control, control of systems with inverse response.

UNIT -III	PROGRAMMABLE LOGIC CONTROL SYSTEMS	Classes:10

Programmable logic control systems: introduction to sequence or logic control and programmable logic controllers, the software environment and programming of PLCs, formal modeling of sequence control specifications.

Programming of PLCs: sequential function charts, the PLC hardware environment.

UNIT -IV	CNC MACHINES AND ACTUATORS	Classes: 9

CNC machines and actuators: Introduction to computer numerically controlled machines, control valves, hydraulic actuation systems, principle and components,

directional control valves, switches and gauges, industrial hydraulic circuits.		
UNIT - V	**ELECTRICAL MACHINE DRIVES**	**Classes: 9**

Electrical machine drives: Energy savings with variable speed drives, step motors: principles, construction and drives, electrical actuators, dc motor drives, electrical actuators: induction motor drives, electrical actuators, BLDC motor drives.

Text Books:

1. Madhu Chanda Mitra, Samarjit Sen Gupta**, "**Programmable Logic Controllers and Industrial Automation:An Introduction", Penram International Publishing (India) Pvt. Ltd**.**, 1st Edition, 2008.
2. K Krishnaswamy,SVijayachitra,"Industrial Instrumentation", New Age Publications, 1st Edition, 2010.
3. Rajesh Mehra, Vikrant Vij**, "**PLCs& SCADA: Theory and Practice", Laxmi publications, 2ndEdition, 2016.

Reference Books:

1. AK Gupta, S.K. Arora**, "**Industrial automation and robotics", Laxmi Publications, 2nd Edition, 2013.
2. Jon Stenerson**, "**Industrial Automation and Process Control", Prentice Hall, 1st Edition, 2002.

Web References:

1. https://www.google.co.in/search?q=INTRODUCTION+TO+INDUSTRIAL+AUTOMATION+AND+CONTROL&ie=utf-8&oe=utf-8&client=firefox-b-ab&gfe_rd=cr&ei=PUocWOXVL67v8weKwZngAw
2. https://www.noorropidah.files.wordpress.com/2012/01/plc-1-3.pdf
3. https://www.radix.co.in/families/automation?gclid=CJfW24PbjtACFUYeaAodiCQGHQ

E-Text Books:

1. https://www.plc-scada-dcs.blogspot.com/p/downloads.html
2. https://www.megawatt.com.gr/files/uploads/KATALOGOS%20PLC%20ABB.pdf

Course Outcome:

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

1. Knows the fundamental concepts about introduction to industrial automation and control and devices.
2. Understand the performance of each system in detail along with practical case studies.
3. Develop various types of industrial automation and control and devices.
4. Understand the process control of PLC automation.
5. Apply Electrical machine drives concept to real world problems.

CO-PO Mapping

(COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	2	2		2					1	2	2
CO 2	3	1	1	2	2		2					1	2	2
CO 3	3	3	3	3	2		2					1	2	2
CO 4	3	3	2	2	2		2					1	2	2
CO 5	3	2		2	3		2					1	2	2
AVG	3	2.4	1.7	2.2	2.2		2					1	2	2

POWER ELECTRONICS AND DISTRIBUTED GENERATION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0206	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes:48	Tutorial Classes:0	Practical Classes: 0				Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

I. Understand distribution system protection and power quality requirements.
II. Discuss distributed generation planning inter connection and protection.
III. Illustrate the various control schemes of DG inverters.

UNIT-I	INTRODUCTION TO DISTRIBUTION SYSTEMS	Classes:10

Overview and technology trends, introduction to distribution systems, radial distribution system protection, fuse, circuit breakers, reclosers, sectionalizers, per-unit analysis, fault analysis, sequence component analysis, sequence models of distribution system components, implications of DG on distribution system protection coordination.

UNIT – II	POWER QUALITY REQUIREMENTS	Classes:9

Source switching using SCR based static switches, distribution system loading, line drop model, series voltage regulators and on-line tap changers, loop and secondary network distribution grids and impact of DG operation.

UNIT – III	PROTECTION AND DG INTERCONNECTION	Classes:9

Relaying and protection, distributed generation interconnection relaying, sensing using CTs and PTs, Islanding distribution systems intentional and unintentional islanding of distribution systems, passive and active detection of unintentional islands, non detection zones.

UNIT – IV	DG PLANNING	Classes:10

DG planning, cost implications of power quality, cost of energy and net present value calculations and implications on power converter design power converter topologies and model and specifications for DG applications, capacitor selection, choice of DC

bus voltage, current ripple, capacitor aging and lifetime calculations, switching versus average model of the power converter and EMI considerations in DG applications, semiconductor device selection, device aging due to thermal cycling, and lifetime calculations.

UNIT – V	**CONTROL OF DG INVERTERS**	**Classes:10**

Phase locked loops, current control and DC voltage control for stand alone and grid parallel operations, protection of the converter, complex transfer functions, VSI admittance model in DG applications, power quality implication, acceptable ranges of voltage and frequency, flicker, reactive power compensation, and active filtering and low voltage ride through requirements.

Text Books:

1. Arthur R. Bergen, Vijay Vittal, "Power Systems Analysis", Prentice Hall, 1999.
2. Ned Mohan, Tore M Undeland, William P. Robbins, "Power Electronics", converters, Applications, and Design; Wiley, 2002.

Reference Books:

1. Math H. Bollen, Finan Hassan, "Integration of Distributed Generation in the Power System
   IEEE Press Series on Power Engineering)", Wiley, 1st Edition, 2011.
2. TuranGonen, "Electric Power Distribution Engineering, CRC Press, 3rd Edition, 2014.
3. E W Kimbark, "Direct Current Transmission", Wiely Inter Science – New York,1st Edition, 1971.

Course Outcome:

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

1. Develop a foundational understanding of distributed systems, showcasing the ability to analyze, design, and implement basic distributed applications, demonstrating knowledge of key concepts such as communication protocols, fault tolerance, and scalability.
2. Demonstrate proficiency in meeting power quality standards, ensuring stable and reliable electrical systems through the application of industry-specific requirements and regulations.
3. Acquire expertise in safeguarding electrical systems and integrating Distributed Generation (DG), demonstrating the ability to design, implement, and maintain effective protection mechanisms for secure and reliable power distribution.
4. Develop skills in Distributed Generation (DG) planning, showcasing the ability to analyze, design, and optimize DG systems for efficient integration into power networks, ensuring reliable and sustainable energy distribution.
5. Attain proficiency in the control of Distributed Generation (DG) inverters, demonstrating the ability to design and implement effective control strategies for

optimal performance and integration into power systems.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	2	2						1	2	2
CO 2	3	2	3	2	2	3						1	2	3
CO 3	3	1	2	2	2	3						1	3	2
CO 4	3		2	3	2	3						1	3	2
CO 5	3	2		2	3	2						1	3	2
AVG	3	2	2.5	2.2	2.2	2.6						1	2.6	2.2

POWER SYSTEM OPERATION AND CONTROL

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0207	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0	Practical Classes: 0			Total Classes: 48			

OBJECTIVES:

The course should enable the students to:

- Optimum generation allocation
- Hydrothermal scheduling and Modeling of turbines and generators
- Load frequency control in single area and two area systems
- Reactive power compensation in power systems
- Power system operation in competitive environment

UNIT-I	ECONOMIC OPERATION	Classes:10

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.

UNIT-II	HYDROTHERMAL SCHEDULING	Classes:10

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

Modeling of Turbine: First Order Turbine Model, Block Diagram Representation of Steam Turbines and Approximate Linear Models.

Modeling of Governor: Mathematical Modeling of Speed Governing System.

Modeling of Generator:

UNIT-III	LOAD FREQUENCY CONTROL	Classes:9

Necessity of Keeping Frequency Constant. Definitions of Control Area – Single Area Control – Block Diagram Representation of an Isolated Power System.

Load Frequency Control of 1-Area System

Steady State Analysis – Dynamic Response – Uncontrolled Case.

Load Frequency Control of 2-Area System – Uncontrolled Case and Controlled Case, Tie-Line Bias Control. Proportional Plus Integral Control of Single Area and Its Block Diagram

Representation, Steady State Response – Load Frequency Control and Economic Dispatch Control.		
UNIT-IV	**REACTIVE POWER CONTROL**	**Classes:10**
Overview of Reactive Power Control – Reactive Power Compensation in Transmission Systems – Advantages and Disadvantages of Different Types of Compensating Equipment for Transmission Systems; Load Compensation – Specifications of Load Compensator, Uncompensated and Compensated Transmission Lines: Shunt and Series Compensation.		
UNIT-V	**POWER SYSTEM OPERATION IN COMPETITIVE ENVIRONMENT**	**Classes:9**
Introduction – Restructuring models – Independent System Operator (ISO) – Power Exchange - Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intra zonal Congestion – Electricity Price Volatility Electricity Price Indexes Challenges to Electricity Pricing		
Text Books:		
1. I Elgerd, "Electrical Energy Systems Theory", Tata Mc Graw Hill, 2nd Edition,2007. 2. Power System Analysis Operation and Control, Abhijit Chakrabarti and Sunita Halder, PHI Learning Pvt. Ltd.,, 3rd Edition, 2010. 3. Modern Power System Analysis, D.P.Kothari and I.J.Nagrath, Tata McGraw Hill Publishing Company Ltd., 3rd Edition, 2003, Ninth Reprint 2007.		
Reference Books:		
1. Power System Analysis and Design, J. Duncan Glover and M.S.Sharma, Thomson, 3rd Edition, 2008. 2. Electric Energy System Theory: An Introduction, OlleIngemarElgerd, Tata McGraw Hill, 2nd Edition, 1982. 3. Power System Stability and Control, P Kundur, Tata Mc Graw Hill, 1994, 5th Reprint, 2008.		
Course Outcomes: After completion of the course, the student will able to: • Analyse the Optimum generation allocation • Develop the mathematical models of turbines and governors • Analyze the Load Frequency Control problem • Explain how shunt and series compensation helps in reactive power control • Explain the issues concerned with power system operation in competitive Environment		

CO-PO Mapping

	PO1	PO2	PO3	PO43	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	2	2		2					2	3	3
CO 2	3	3	3	2	2		2					2	3	3
CO 3	3	3	2	2	2		2					2	3	3
CO4	3	2	2	2	2		2					2	3	3
CO5	3	2	1	3	2		2					2	3	3
AVG	3	2.4	2.2	2.2	2		2					2	3	3

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LABORATORY

Course Code	Category	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0220	PROFESSIONAL CORE	-	-	3	1.5	40	60	100
Contact Classes: 0	Tutorial Classes: 0		Practical Classes:48			Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

I. Understand various measurement techniques used in electrical engineering.
II. Analyse waveforms using LabVIEW to measure various parameters.
III. Demonstrate the use of sensors and transducers in electrical and nonelectrical measurements.
IV. Apply knowledge of virtual instruments in measurement of analysis of electrical parameters.

LIST OF EXPERIMENTS	
Expt. 1	**SENSING OF TEMPERATURE**
Measurement of temperature using transducers like, thermistors	
Expt. 2	**MEASUREMENT OF LOW RESISTANCE**
Kelvin's Double Bridge – Measurement of Resistance – Determination of Tolerance	
Expt. 3	**CALIBRATION OF DYNAMO METER POWER FACTOR METER**
Calibration of Dynamometer Power Factor Meter.	
Expt. 4	**MEASUREMENT OF PARAMETERS OF A CHOKE COIL**
Measurement of Parameters of a Choke Coil Using 3 Ammeter Method	
Expt. 5	**PHANTOM LOADING ON LPF WATTMETER**
Calibration of Electrodynamometer type LPF wattmeter using phantom loading	
Expt. 6	**CALIBRATION OF SINGLE PHASE ENERGY METER AND**

	POWER FACTOR METER
Calibration of single phase energy meter using resistive load and dynamometer power factor meter.	
Expt. 7	**MEASUREMENT OF PARAMETERS OF A CHOKE COIL**
Measurement of Parameters of a Choke Coil Using 3 Voltmeter Method	
Expt. 8	**MEASUREMENT OF REACTIVE POWER**
Measurement of reactive power using one single phase wattmeter.	
Expt. 9	**MEASUREMENT OF FREQUENCY AND PHASE VOLTAGE BY CRO**
Measurement of frequency and phase voltage by CRO.	
Expt. 10	**SCHERING BRIDGE**
Measurement of unknown capacitance using scheringbribge.	
Expt. 11	**ANDERSON BRIDGE**
Measurement of unknown inductance using Andersons bridge.	
Expt. 12	**MEASUREMENT OF REAL AND REACTIVE POWERS BY TWO WATTMETER METHOD**
Measurement of real and reactive powers of an electrical load using two wattmeter method	
Reference Books:	
1. https://www.bookpump.com/bwp/pdf-b/2335004b.pdf. 2. https://www.books.google.co.in › Technology & Engineering › Sensors 3. https://www.bambang.lecturer.pens.ac.id/rekayasa%20sensor%20aktuator/Sensors%20&%20Trans... 4. https://www.sae.org/images/books/toc_pdfs/BELS036.pdf	
Web References:	
1. https://www.gnindia.dronacharya.info/EEEDept/Downloads/Labmanuals/EMI_Lab.pdf 2. https://www.scribd.com/doc/25086994/electrical-measurements-lab	
Course Home Page:	
SOFTWARE AND HARDWARE REQUIREMENTS : **SOFTWARE:**MATLAB R2015a **HARDWARE:**Desktop Computers (04 nos)	
Course Outcome: At the end of the course, a student will be able to: 1. Calibrate various Measuring /Integrating/recording type Measuring instruments 2. Measure Resistance inductance capacitance using DC ,AC bridges 3. Measure Parameters of Choke coil.	

4. Measure power /Reactive power/ power factor of 3 phase balance unbalance loads
5. Measure Frequency and Phase Voltage By CRO
6. Follow the ethical principles in implementation of experiments
7. Do Experiments effectively as individual and as team member in a group
8. Communicate verbally and in written form, understanding about the experiments
9. Continue Updating the skills related to contemporary technology

	PO1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	2	3					2	2			2	1
CO 2	3	2		3					2	2			2	1
CO 3	3	2		3					2	2			2	1
CO 4	3	2		3					2	2			2	1
CO 5	3	1		2					1	2			2	1
CO 6								3					1	1
CO 7									3				1	1
CO 8										3			1	1
CO 9												3	1	1
AVG	3	1.8	2	2.8				3	2	2.1		3	1.5	1

COMPUTER AIDED DESIGN LABORATORY

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0221	PROFESSIONAL CORE	-	-	3	1.5	40	60	100
Contact Classes: 0	Tutorial Classes: 0	Practical Classes: 48			Total Classes: 48			

OBJECTIVES:

The course should enable the students to:

- Simulate transmission line parameters using MATLAB
- Analyze stability in power systems.
- Simulate different power electronic converters.

LIST OF EXPERIMENTS

Expt. 1	ABCD Parameters For T Network of Transmission lines ABCD Parameters For Long Transmission Network
Expt.2	Reactive Power And Power Factor Correction
Expt.3	Two Area Power System
Expt.4	Modeling of Two-Area Power System
Expt.5	Single Machine Infinite Bus
Expt.6	Load Frequency Control
Expt.7	Simulation of Single Phase Half Bridge Rectifier
Expt.8	Simulation of Single Phase Full Bridge Rectifier
Expt.8	Simulation of Three Phase Semi Bridge Rectifier
Expt.10	Simulation of Single Phase Inverter
Expt.11	Simulation of Three Phase Inverter for 120^{o} and 180^{o} Conduction angle
Expt. 12	Simulation of Three Phase AC Voltage Regulator

Expt.13	Simulation of Three Phase Duel Converter.

Reference Books:

1. MAPai, "Computer Techniques in Power System Analysis", TMH Publications, 1st Edition, 2010
2. Grainger, Stevenson , "Power System Analysis", Tata McGraw Hill, 1st Edition, 2010

Web References:

1. https://www.ee.iitkgp.ac.in
2. https://www.crectirupati.com

Course Outcomes:

The student can able to

1. Simulate transmission line parameters using MATLAB/Simulink.
2. Simulate the stability of power system network using MATLAB Simulink.
3. Simulate and obtain different firing pulses for Power Electronic Converters using MATLAB/Simulink.
4. Simulate and obtain waveforms for different firing angle of Power Electronics Converter using MATLAB/Simulink.
5. Simulate different Power Electronic Circuits using MATLAB/Simulink.
6. Follow the ethical principles in implementation of experiments
7. Do Experiments effectively as individual and as team member in a group
8. Communicate verbally and in written form, understanding about the experiments
9. Continue Updating the skills related to contemporary technology

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	3	2	3				2	2		1	3	2
CO 2	3	3	2	3	3				2	2		1	3	2
CO 3	3	2	3	2	3				2	2		1	3	2
CO 4	3	2	3	2	3				2	2		1	3	2
CO 5	3	3	2	3	3				2	2		1	3	2
CO 6								3					1	1
CO 7									3				1	1
CO 8										3			1	1
CO 9												3	1	1
AVG	3	2.4	2.6	2.6	3			3	2.1	2.1		1.3	2.1	1.5

MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

Course Code	Category	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0416	PROFESSIONAL CORE	-	-	3	1.5	40	60	100
Contact Classes: Nil	Tutorial Classes:	Practical Classes: 48				Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

1. Develop assembly language programs and provide the basics of the microprocessors.
2. Understanding the interfacing of external devices to the processor and controller for various applications.
3. Learn Embedded C programming using MSP430microcontroller.
4. Develop ability in programming using microprocessor and microcontroller.

LIST OF EXPERIMENTS

WEEK – 1	**DESIGN A PROGRAM USING WIN862**

Design and develop an Assembly language program using 8086 microprocessor and to show the following aspects.

a) Programmingb)Execution c)Debugging

To Demonstrate the MASM/TASM software and Trainer kit for 8086 Microprocessor

WEEK-2	**16 –BIT ARITHMETIC AND LOGICAL OPERATIONS**

Write an ALP program to perform 16 Bit arithmetic and logical operations.

WEEK-3	**MULTIBYTE ADDITION AND SUBRACTION**

Write an ALP program to perform multi byte addition and subtraction.

WEEK -4	**PROGRAMS TO SORT NUMBERS**

a) Write an ALP program to perform ascending order using8086

b) Write an ALP program to perform descending order using8086

WEEK -5	**PROGRAMS FOR STRING MANIPULATIONS OPERATIONS**

a) Write an ALP program to insert or delete a byte in the givenstring

b) Write an ALP program to search a number/character in a givenstring

c) Write an ALP program to move a block of data from one memory

location to theother d) Write an ALP program for reverse of a givenstring	
WEEK -6	**CODE CONVERSIONS**
Write an ALP program to convert packed BCD to Unpacked BCD	
WEEK -7	**INTERFACING AND PROGRAMMING GPIO PORTS IN Embedded C USING MSP430**
Interfacing and programming GPIO ports in Embedded C using MSP430 (blinking LEDs)	
WEEK -8	**INTERFACING AND PROGRAMMING GPIO PORTS IN Embedded C USING MSP430**
Interfacing and programming GPIO ports in Embedded C using MSP430 (LED blink using push button)	
WEEK-9	**USAGE OF LOW POWER MODES**
a) Measure the active modecurrent b) Standby mode current using MSPEXP430FR5969 ashardware	
WEEK-l0	**USING ULP ADVISOR**
Using ULP advisor in Code Composer Studio on MSP430	
WEEK-11	**LOW POWER MODES AND ENERGY TRACE++**
a) Enable Energy Trace and Energy Trace ++ modes in CCStudio b) Compute Total Energy, and Estimated lifetime of an AAbattery.	
WEEK-l2	**PWM GENERATION**
PWM generation using Timer on MSP430 GPIO	

Reference Books:

1. A.K.Ray&K.M.Bhurchandi "Advanced Microprocessor and Peripherals", 2nd Edition TMH,2012
2. MSP430 microcontroller basics. John H. Davies, Newnes Publication, 1st Edition, 2008.

Web References:

1. http://www.nptel.ac.in/downloads/106108100
2. http://www.the8051microcontroller.com/web-references

Outcomes:

After studying this course the students would be able to

1. CO1: Study the Architecture of 8086 microprocessor.
2. CO2: Learn the design aspects of I/O and Memory Interfacing circuits.
3. CO3: Study the Architecture of MSP430 Microcontroller.
4. CO4: To understand MSP430 Microcontroller programming and interfacing
5. CO5: Work independently and in teams to solve problems with effective Communication.
6. CO6: Follow the ethical principles in implementation of experiments.
7. CO7: Do Experiments effectively as individual and as team member in a group.
8. CO8: Communicate verbally and in written form, understanding about the experiments.
9. CO9: Continue Updating the skills related to contemporary technology.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	3	-	-	-	-	-	-	-	3	2
CO2	3	1	-	2	-	-	-	-	-	-	-	-	3	2
CO3	3	2	-	1	3	-	-	-	-	-	-	-	3	2
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	2
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	1
CO6	-	-	-	-	-	-	-	3	-	-	-	-	1	1
CO7	-	-	-	-	-	-	-	-	3	-	-	-	1	1
CO8	-	-	-	-	-	-	-	-	-	3	-	-	1	1
CO9	-	-	-	-	-	-	-	-	-	-	-	3	1	1
AVG	3	2	2	1.5	3	-	-	3	3	3	-	3	2.1	1.4

VII SEMESTER

UTILIZATION OF ELECTRICAL ENERGY

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0208	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes:48			

OBJECTIVES:

The course should enable the students to:

- To analyze the various concepts behind renewable energy resources.
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To introduce knowledge on Solar Radiation and Solar Energy Collectors.
- To introduce concepts of Wind Energy and its utilization.

UNIT-I	ILLUMINATION	Classes:10

Introduction - definition and meaning of terms used in illumination engineering, law of illumination - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.

UNIT-II	HEATING AND WELDING	Classes:09

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding, equipment used for arc welding

UNIT-III	ELECTRIC TRACTION – I	Classes:10

Introduction – Systems of Electric Traction. Comparison Between A.C and D.C 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.

UNIT-IV	ELECTRIC TRACTION – II	Classes:10

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

UNIT-V	INTRODUCTION TO ELECTRIC AND HYBRID VEHICLES	Classes:9

Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement, vehicle performance and energy consumption.

Text Books:

1. N.V. Suryanarayana, "Utilisation of Electric Power", Wiley Eastern Limited, New Age
International Limited,1993.
2. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons, 2000.
3. G.D.Rai, "Non-Conventional Energy Sources", Khanna Publications Ltd., New Delhi, 1997.

Reference Books:

1. R.K.Rajput, Utilisation of Electric Power, Laxmi publications Private Limited.,2007.
2. H.Partab, Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New
Delhi, 2004.
3. C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age
International Pvt.Ltd., 2003.
4. S. Sivanagaraju, M. Balasubba Reddy, D. Srilatha,' Generation and Utilization of Electrical
Energy', Pearson Education, 2010.
5. Donals L. Steeby,' Alternative Energy Sources and Systems', Cengage Learning, 2012.

Course Outcomes:

At the end of the course a student will be able to:

1. Develop a lighting scheme for a given practical case.
2. Analyze the concept of the electric drive and traction.
3. Analyze the performance of Heating and Welding methods

4. Analyze the performance of electric vehicles.
5. Analyze traction motor characteristics.

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	SPO2
CO 1	3	3	3	2	2		2					1	2	1
CO 2	3	3	2	2	2		2					1	3	2
CO 3	3	2	1	3	2		2					1	2	1
CO4	3	2	2	2	2		2					1	3	2
CO5	3	1	2	1	2		2					1	3	2
AVG	3	2.2	2	2	2		2					1	2.6	1.6

POWER SYSTEMS STABILITY

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0209	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0	Practical Classes: 0			Total Classes: 48			

OBJECTIVES:

The course should enable the students to:

- Demonstrate various power system stability problems using single machine infinite bus configuration.
- Apply and explain different methods for analyzing power system stability.
- Create mathematical models for studying dynamic and stability of a power system.
- Illustrate different power system controls, and their impact on the system stability.

UNIT – I	INTRODUCTION TO POWER SYSTEM STABILITY PROBLEMS	Classes:10

Definition of stability, classification of stability, rotor angle stability, frequency stability, voltage stability, midterm and long term stability, classical representation of synchronous machine in a single machine infinite bus system (SMIB), equal area criterion to asses stability of a single machine infinite bus system, limitations of classical model of synchronous machines.

UNIT – II	MODELING OF POWER SYSTEM COMPONENTS FOR STABILITY ANALYSIS	Classes:10

Synchronous machine modeling: Sub transient model, two axis model, one axis (flux decay) model, classical model; Excitation systems modeling: DC excitation, AC excitation and static excitation, prime mover and energy supply systems modeling, transmission line modeling, load modeling, methods of representing synchronous machines in stability analysis.

UNIT – III	SMALL SIGNAL STABILITY	Classes: 10
Fundamental concepts, state space representation, modal analysis: Eigen properties, participation factors, stability assessment, effects of excitation system on stability. Power system stabilizer and its design, angle and voltage stability of multi machine power systems and phenomenon of sub synchronous resonance.		
UNIT – IV	**TRANSIENT STABILITY**	**Classes: 9**
Fundamentals of transient stability, numerical solutions: simultaneous implicit and partitioned explicit methods, simulation of dynamic response, analysis of unbalanced faults, direct method of transient stability, transient energy function method, methods of improving transient stability.		
UNIT – V	**VOLTAGE STABILITY**	**Classes: 9**
Classification of voltage stability, modeling requirements, voltage stability analysis, static and dynamic, sensitivity analysis, modal analysis, voltage collapse.		

Text Books:

1. P Kundur, "Power system stability and control",TataMcGraw Hill, 1st Edition, 2001.
2. K R Padiyar, "Power system dynamics", BSP publications, 2nd Edition, 2010.
3. MAPai and Peter WSauer, "Power system stability", Pearson Education, 1st Edition, 2000.

Reference Books:

1. MAPai,K Sengupta and K RPadiyar, "Topics on small signal stability analysis", Tata-McGraw Hill, 1st Edition, 2005 .
2. Paul M Anderson and A A Fouad, "Power system stability",Wiley-interscience, 1st Edition, 2002.

Web References:

1. https://www.researchgate.net
2. https://www.aar.faculty.asu.edu/classes
3. https://www.facstaff.bucknell.edu/
4. https://www.electrical4u.com
5. https://www.crectirupati.com

E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com

Course Outcomes:

At the end of the course a student will be able to:

1. Make all numerical calculations for power system stability problems using single machine infinite bus configuration.
2. Analyse different methods for power system stability.
3. Create mathematical models for studying dynamic and transient stability of a power system.
4. Master small signal stability analysis, showcasing the ability to evaluate and enhance the stability of power systems under small disturbances for reliable and secure operation.
5. Analyze different power system controls and their impact on the system voltage stability.

CO-PO MAPPING

	PO1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	2	2		2						3	2
CO 2	3	2	2	2	2		2					1	3	2
CO 3	3	3	3	3	2		2						3	2
CO4	3	2	2	2	2		2					1	3	2
CO5	3	1	3	2	2		2					1	3	2
AVG	3	2.2	2.4	2.2	2		2					0.6	3	2

FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSTEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0214	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

The course should enable the students to: The objectives of the course are to make the students learn about:

- The basic concepts, different types, and applications of FACTS controllers in
- power transmission.
- The basic concepts of static shunt and series converters
- The working principle, structure and control of UPFC

UNIT – I	CONCEPTS OF FLEXIBLE AC TRANSMISSION SYSTEMS	Classes: 10

Transmission line Interconnections, Power flow in parallel lines, Mesh systems, Stability considerations, Relative importance of controllable parameters, Basic types of FACTS controllers, Shunt controllers, Series controllers, Combined shunt and series controllers, Benefits of FACTS.

UNIT – II	VOLTAGE AND CURRENT SOURCED CONVERTERS	Classes: 10

Concept of Voltage Sourced Converters, Single Phase Full Wave Bridge Converter, Three Phase Full Wave Bridge Converter, Transformer Connections for 12-Pulse Operation, 24 and 48-Pulse Operation, Three Level Voltage Sourced Converter, Pulse Width Modulation (PWM) Converter, Converter Rating, Concept of Current Sourced Converters, Thyristor based converters, Current Sourced Converter with Turn off Devices, Current Sourced –vs- Voltage Sourced Converters.

UNIT - III	STATIC SHUNT COMPENSATORS	Classes: 10
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, Methods of Controllable VAR Generation, Variable Impedance Type Static VAR Generators, Switching Converter Type VAR mGenerators, Hybrid VAR Generators, SVC and STATCOM, Transient Stability Enhancement and Power Oscillation Damping, Comparison Between STATCOM and SVC, V-I, V-Q Characteristics, Response Time.		
UNIT - IV	**STATIC SERIES COMPENSATORS**	**Classes: 9**
Objectives of Series Compensation, Voltage Stability, Improvement of Transient Stability, Power Oscillation Damping, Subsynchronous Oscillation Damping, Variable Impedance Type Series Compensators, GTO Thyristor Controlled Type Series Capacitor (GCSC), Thyristor Switched Series Capacitor (TSSC), Thyristor-Controlled Series Capacitor(TCSC), Basic Operating Control Schemes for GCSC, TSSC, and TCSC, Switching Converter Type Series Compensators, The Static Synchronous Series Capacitor(SSSC), Transmitted Power Versus Transmission Angle Characteristic, Control Range and VA Rating, Capability to Provide Real Power Compensation.		
UNIT - V	**POWER FLOW CONTROLLERS**	**Classes: 9**
The Unified Power Flow Controller-Basic Operating Principles, Conventional Transmission Control Capabilities, Independent Real and Reactive Power Flow Control. Control Structure, Basic Control System for P and Q Control, Dynamic Performance, The Interline Power Flow Controller (IPFC), Basic Operating Principles and Characteristics, Generalized and Multi controller FACTS controllers.		

Text Books:

1. Mohan Mathur, R Rajiv K Varma, "Thyristor – Based FACTS controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, 1st Edition, 2002.
2. K RPadiyar," FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd., Publishers, 1st Edition, 2008.
3. A T John, "Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE),2ndEdition, 1999.

Reference Books:

1. Narain G Hingorani, LaszioGyugyl, "Understanding FACTS Concepts and Technology of Flexible AC Transmission System", Standard Publishers, 1st Edition, 2001.
2. K Sood, "HVDC and FACTS controllers- Applications of Static Converters in Power System", Kluwer Academic Publishers,1st Edition, 2004.

Web References:

1. https://www.researchgate.net

2. https://www.aar.faculty.asu.edu/classes

E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com

Course Outcome:

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

1. Knows the concept of available FACTS Controllers and able to analysis the power flow control in AC Transmission line.
2. Analyze and implement FACTS with Voltage and Current soured converters.
3. Analyze the static series and shunt control FACTS devices.
4. Demonstrate proficiency in understanding and applying static series compensators, showcasing the ability to analyze, design, and optimize their use in power systems for voltage control and stability enhancement.
5. Analyze the performance of UPFC and IPFC for enhancing the transmission capability

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	2	2	2		3						3	3
CO 2	3	2	3	2	2		2						3	3
CO 3	3	2	3	3	2		2						3	3
CO4	3	2	3	2	2		2						3	3
CO5	3	1	3	2	2		2						3	3
AVG	3	1.6	2.8	2.2	2		2.2						3	3

POWER SYSTEM TRANSIENTS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0211	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

- Summarize the generation of switching transients and their control using circuit, theoretical concepts and analyze security and contingency evaluation.
- Discuss the mechanism of lighting strokes and the production of lighting surges.
- Outline the propagation, reflection and refraction of travelling waves.
- Appraise the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT-I	INTRODUCTION TO TRANSIENTS	Classes: 10

Study of transients: Review and importance of the study of transients, causes for transients, RL circuit transient with sine wave excitation, double frequency transients, basic transforms of the RLC circuit transients, different types of power system transients, effect of transients on power systems, role of the study of transients in system planning.

UNIT - II	SWITCHING TRANSIENTS	Classes: 10

Switching transients: Over voltages due to switching transients, resistance switching and the equivalent circuit for interrupting the resistor current, load switching and equivalent circuit, waveforms for transient voltage across the load and the switch, normal and abnormal switching transients; Effects of switching transients: Current suppression, current chopping, effective equivalent circuit, capacitance switching, effect of source regulation, capacitance switching with a restrike, with multiple re strikes, illustration for multiple restriking transients, Ferro resonance

UNIT - III	LIGHTNING TRANSIENTS	Classes: 10

Cloud formation: Review of the theories regarding the formation of clouds and charge formation, rate of charging of thunder clouds.

Characteristics of lightning transients: Mechanism of lightning discharges and

characteristics of lightning strokes, model for lightning stroke, factors contributing to good line design, protection using ground wires, tower footing resistance , interaction between lightning and power system.		
UNIT - IV	**TRAVELING WAVES ON TRANSMISSION LINE - COMPUTATION OF TRANSIENTS**	**Classes: 9**
Computation: Computation of transients, transient response of systems with series and shunt lumped parameters and distributed lines; Travelling wave: Traveling wave concept, step response, Bewely's lattice diagram, standing waves and natural frequencies, reflection and refraction of travelling waves.		
UNIT - V	**TRANSIENTS IN INTEGRATED POWER SYSTEM**	**Classes: 9**
Integrated power systems transients: The short line and kilometric fault, distribution of voltages in a power system, line dropping and load rejection, voltage transients on closing and reclosing lines, over voltage induced by faults, switching surges on integrated system qualitative application of EMTP for transient computation.		

Text Books:

1. Allan Greenwood, "Electrical Transients in Power Systems", Wiley Inter Science, NewYork,2nd Edition, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., 2nd Edition, 2009.
3. C S Indulkar, D P Kothari, K Ramalingam, "Power System Transients: A statistical approach", Prentice Hall of India, 2nd Edition, 1996.

Reference Books:

1. M S Naidu, V Kamaraju, "High Voltage Engineering", Tata McGraw Hill, 5th Edition, 2013.
2. RD Begamudre, "Extra High Voltage AC Transmission Engineering", Wiley EasternLimited,2nd Edition , 1986.
3. Y Hase, "Handbook of Power System Engineering", Wiley India, 1st Edition 2012.
4. J L Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use", Wiley, 1st Edition, 2012.

Web References:

1. https://www.researchgate.net/.../3275167_Categorization_and_Analysis_of_Power_Sy..
2. https://www.ece.mtu.edu/faculty/bamork/ee5220/
3. *https://www.books.google.co.in/books?isbn=1466577843*
4. *https://www.studyname.com/community/archive/index.php/t-351.html***.**

E-Text Books:

1. https://www.crcpress.com/Power-System-Transients
2. *https://www.chegg.com › ... › electronics › power system transients*

Course Outcomes:

The student should have learnt about:

1. Develop a foundational understanding of transients, demonstrating the ability to identify, analyze, and mitigate transient phenomena in electrical systems for improved reliability and performance.
2. Gain expertise in switching transients, showcasing the ability to analyze and manage transient effects during circuit switching, ensuring stable and efficient operation in electrical systems.
3. Master the understanding of lightning transients, demonstrating the ability to analyze and implement protective measures to minimize the impact of lightning-induced disturbances in electrical systems for enhanced reliability.
4. Develop proficiency in analyzing and understanding traveling waves on transmission lines, showcasing the ability to assess and manage wave propagation for improved performance and reliability in electrical power systems.
5. Acquire expertise in handling transients in integrated power systems, demonstrating the ability to identify, analyze, and implement strategies to mitigate transient effects, ensuring stability and reliability in complex power networks.

CO-PO MAPPING

	PO1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO12**	**PO12**
CO 1	3	2	3	3	2		3						3	3
CO 2	3	2	2	1	2		2						3	3
CO 3	3			2	2		3						3	3
CO 4	3	3	3		2		2						3	3
CO 5	3	3	3	2	2		3						3	3
AVG	3	2	2.2	1.6	2		2.6						3	3

ELECTRICAL DRIVES

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0212	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of dc motors and induction motors.
2. Understand the principles of speed-control of dc motors and induction motors.
3. Understand the power electronic converters used for dc motor and induction motor speed control.

UNIT-I	CONVERTER FED DC MOTORS	Classes: 10

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.

UNIT - II	FOUR QUADRANT OPERATION OF DC DRIVES	Classes: 10

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)

UNIT - III	CHOPPER FED DC MOTORS	Classes: 10

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

UNIT - IV	CONTROL OF INDUCTION MOTOR	Classes: 9

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

UNIT - V	**CONTROL OF SYNCHRONOUS MOTORS**	**Classes: 9**

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), Introduction to variable frequency control.

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 Outcomes:

The student should be able to:

- Identify the choice of the electric drive system based on their applications
- Explain the operation of single and multi quadrant electric drives
- Analyze single phase and three phase rectifiers fed DC motors as well as chopper fed DC motors
- Analyze the speed control methods for AC-AC & DC-AC converters fed to Induction motors with closed loop, and open loop operations
- Analyze the speed control methods for AC-AC & DC-AC converters Synchronous motors with closed loop, and open loop operations.

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	3	2	2		3						3	3
CO 2	3	1	1	2	2		2						3	3
CO 3	3	2	2	2	2		2						3	3
CO4	3	2	3	2	2		2						3	3
CO5	3	2	3	2	2		2						3	3
AVG	3	1.8	2.4	2	2		2.2						3	3

HVDC TRANSMISSION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0213	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

- Understand the basic concepts of HVDC transmission systems and various converters.
- Discus reactive power control in HVDC systems.
- Analyse power flow in AC-DC systems.

UNIT-I	BASIC CONCEPTS	Classes: 10

Economics and Terminal equipment of HVDC transmission systems: Types of HVDC links, apparatus required for HVDC Systems, comparison of AC and DC transmission, application of DC transmission system, planning and modern trends in DC transmission.

UNIT-II	ANALYSIS OF HVDC CONVERTERS	Classes: 10

Analysis of HVDC converters: Choice of converter configuration, analysis of Graetz, characteristics of 6 Pulse and 12 Pulse converters, cases of two 3 phase converters in star-star mode and their performance.

UNIT-III	CONVERTER AND HVDC SYSTEM CONTROL	Classes: 10

HVDC system Control: Principal of DC link control, converters control characteristics, firing angle control, current and extinction angle control.

Power control in HVDC systems: Effect of source inductance on the system, starting and stopping of DC link, power control.

UNIT-IV	REACTIVE POWER CONTROL AND FILTERS	Classes: 9

Reactive Power Control: Reactive Power Requirements in steady state, conventional control strategies, alternate control strategies, sources of reactive power, AC filter, shunt capacitors, synchronous condensers.

UNIT-V	POWER FLOW ANALYSIS IN AC/DC SYSTEMS	Classes: 9

Power flow Analysis: Modeling of DC links, DC network, DC converter-controller equations, solution of DC load flow, PU System for DC quantities, solution of AC-DC power flow, simultaneous method, sequential method.

Text Books:

1. K RPadiyar, "HVDC Power Transmission Systems: Technology and system Interactions", New Age International (P) Limited, 1st Edition, 1999.
2. SRao, "EHVAC and HVDC Transmission Engineering and Practice", PHI, 3rd Edition, 1990.

Reference Books:

1. J Arrillaga, "HVDC Transmission", Institution of Electrical Engineers, 1st Edition, 1998.
2. EWKimbark, "Direct Current Transmission ", John Wiley & Sons, 1st Edition, 1971.
1. E Uhlmann, "Power Transmission by Direct Current", B SPublications, 1st Edition, 1975.

Course Outcome:

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

1. Develop a foundational understanding of basic concepts in HVDC transmission, demonstrating the ability to analyze, comprehend, and apply key principles for efficient and reliable high-voltage direct current transmission systems.
2. Attain proficiency in the analysis of HVDC converters, showcasing the ability to understand, model, and evaluate the performance of high-voltage direct current converters for effective power transmission.
3. Master reactive power control and filters, showcasing the ability to design, implement, and optimize systems for efficient management of reactive power.
4. Master control techniques for converters and HVDC systems, demonstrating the ability to design, implement, and optimize control strategies
5. Gain expertise in power flow analysis for AC/DC systems, demonstrating the ability to analyze and optimize electrical networks to ensure efficient and stable power transmission.

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	2	2		2						3	3
CO 2	3	3	3	3	2		2						3	3
CO 3	3	2		2	2		2						3	3
CO4	3	2	1	2	2		2						3	3
CO5	2	2	1	2	2		2						3	3

AVG	2.2	1.75	2.2	2	2		2						3	3

HIGH VOLTAGE ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0210	PROFESSIONAL ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

To impart knowledge on the following Topics

- Various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination

UNIT-I	OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS	Classes: 10

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages, Corona and its effects – Bewley lattice diagram- Protection against over voltages.

UNIT-II	DIELECTRIC BREAKDOWN	Classes: 10

Properties of Dielectric materials - Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics- Applications of insulating materials in electrical equipments.

UNIT-III	GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS	Classes: 10

Generation of High DC voltage: Rectifiers, voltage multipliers, vandigraff generator: generation of high impulse voltage: single and multistage Marx circuits – generation of high AC voltages: cascaded transformers, resonant transformer and tesla coil- generation of switching surges – generation of impulse currents - Triggering and control of impulse

generators.		
UNIT-IV	**MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS**	**Classes: 9**
High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.		
UNIT-V	**HIGH VOLTAGE TESTING & INSULATION COORDINATION**	**Classes: 9**
High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination& testing of cabilitys.		

Text Books:

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier , New Delhi, 2005.
3. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Third Edition, 2010.

Reference Books:

1. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
2. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, Roshday Radwan, High Voltage Engineering – Theory &Practice, Second Edition Marcel Dekker, Inc., 2010.
3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.

Course Outcome:

At the end of course the student is able to

1. Acquire knowledge in overvoltages in electrical power systems, showcasing the ability to analyze, identify, and implement measures to mitigate overvoltage issues for enhanced system reliability.
2. Develop an understanding of dielectric breakdown, demonstrating the ability to analyze factors leading to breakdown and implement preventive measures for ensuring electrical insulation integrity. understand Generation, measurement and testing of high voltage.
3. Attain proficiency in generating high voltages and currents, showcasing the ability to design, operate, and troubleshoot systems for diverse applications in electrical engineering.
4. Master the measurement of high voltages and currents, demonstrating the ability to

employ accurate techniques and instruments for precise analysis and monitoring in electrical systems.

5. Acquire expertise in high voltage testing and insulation coordination, demonstrating the ability to conduct effective tests and ensure optimal insulation design for enhanced electrical system reliability.

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2		1	2		3						3	3
CO 2	3	2	1	1	2		2						3	3
CO 3	3	3	2	2	2		2						3	3
CO4	3	2	3	1	3		2						3	3
CO5	3	2	2	2	2		3						3	3
AVG	3	2.2	2	1.4	2.2		2.4						3	3

ADVANCED POWER SYSTEM PROTECTION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0215	PROFESSIONAL ELECTIVE	3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

- Illustrate concepts of transformer protection.
- Describe about the various schemes of over current protection.
- Analyze three stepped distance and carrier protection of transmission lines.
- Outline the concepts of bus bar protection and numerical over current and distance protection.

UNIT - I	OVER CURRENT PROTECTION	Classes: 10

Zones of protection: Primary and Backup protection, operating principles and relay construction, time current characteristics, current setting, time setting, over current protective schemes, reverse power or directional relay, protection of parallel feeders, protection of ring feeders, earth fault and phase fault protection, combined earth fault and phase fault protection scheme, phase fault protective scheme directional earth fault relay ,static over current relays; numerical example for a radial feeder.

UNIT - II	EQUIPMENT PROTECTION	Classes: 10

Types of transformers, phasor diagram for a three Phase transformer, equivalent circuit of transformer, types of faults in transformers, over current protection percentage differential Protection of transformers, Inrush phenomenon, high resistance ground faults in transformers, inter turn faults in transformers, incipient faults in transformers, Phenomenon of over fluxing in transformers, transformer protection application chart; Generator protection: Electrical circuit of the generator, various faults and abnormal operating conditions, stator faults rotor faults, abnormal operating conditions; numerical examples for typical transformer and generator protection schemes

UNIT - III	DISTANCE AND CARRIER PROTECTION OF TRANSMISSION LINES	Classes: 10

Drawback of over current protection, introduction to distance relay simple impedance relay, reactance relay, mho relays comparison of distance relay, distance protection of a three phase line, reasons for inaccuracy of distance relay reach, three stepped distance protection, trip contact configuration for the three stepped distance protection, three stepped protection of three phase line against all ten shunt faults, impedance seen from relay side, three stepped protection of double end fed lines.

Need for carrier , aided protection ,various options for a carrier, coupling and trapping the carrier into the desired line section, unit type carrier aided directional comparison relaying, carrier aided distance schemes for acceleration of zone II, numerical example for a typical distance protection scheme for a transmission line.

UNIT - IV	BUSBAR PROTECTION	Classes: 9

Introduction differential protection of bus bars, external and internal fault, actual behaviors of a protective CT, circuit model of a saturated CT , external fault with one CT saturation need for high impedance, minimum internal fault that can be detected by the high ,stability ratio of high impedance bus bar differential scheme, supervisory relay, protection of three phase bus bars, numerical examples on design of high impedance bus bar differential scheme.

UNIT - V	NUMERICAL PROTECTION	Classes: 9

Introduction, block diagram of numerical relay, sampling theorem, correlation with a reference wave least error squared (LES) technique, digital filtering, numerical over current protection, numerical transformer differential protection, numerical distance protection of transmission line.

Text Books:

1. P Kundur, “Power System Stability and Control”, McGraw-Hill, 1st Edition, 1993.
2. Stanley Horowitz, “Protective Relaying for Power System II”,,IEEE press , New York, 2nd Edition, 2008.
3. T SM Rao, Digital Relay, “ Numerical relays”, Tata McGraw Hill, New Delhi, 1st Edition, 1989.

Reference Books:

1. YG Paithankar and S.R Bhide, “Fundamentals of Power System Protection”, Prentice-Hall of India, 3rd Edition, 2003.
2. Badri Ram, DN Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw- Hill Publishing Company,1st Edition, 2002.

Course Outcomes:

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

1. Understand the various schemes of over current protection.
2. Understand the concepts of transformer and generator protection.
3. Analyse three zone distance and carrier protection of transmission lines.

4. Study and analyze of the concepts of bus bar protection
5. Study and analyze of numerical over current and distance protection.

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3		2		2		2						3	3
CO 2	3	2	2		2		2						3	3
CO 3	3	2	2	2	3		2						3	3
CO4	3	2	3	2	2		2						3	3
CO5	3	3	2	2	3		2						3	3
AVG	3	2.2	2.2	2	2.4		2						3	3

SMART GRID TECHNOLOGY

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0216	PROFESSIONAL ELECTIVE	3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0	Practical Classes: Nil				Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

- Discuss the concepts and design of Smart grid.
- Describe the communication and measurement technologies employed in smart grid.
- Demonstrate the tools for the performance analysis and stability analysis of smart grid.
- Discuss the renewable energy resources and storages integrated with smart grid.

UNIT-I	SMART GRID ARCHITECTURAL DESIGNS	Classes: 10

Introduction comparison of power grid with smart grid power system enhancement, communication and standards, general view of the smart grid market drivers, stakeholder roles and function, measures representative architecture, functions of smart grid components, wholesale energy market in smart grid smart vehicles in smart grid.

UNIT - II	SMART GRID COMMUNICATIONS AND MEASUREMENT TECHNOLOGY	Classes: 10

Communication and measurement, monitoring, phasor measurement unit, smart meters, wide area monitoring systems, advanced metering infra structure and Google mapping tools.

UNIT - III	PERFORMANCE ANALYSIS TOOLS FOR SMART GRID DESIGN	Classes: 10

Introduction to load flow studies, challenges to load flow in smart grid and weaknesses of the present load flow methods, load flow state of the art: classical, extended formulations, and algorithms.

Load flow for smart grid design, contingencies studies for smart grid.

UNIT - IV	STABILITY ANALYSIS TOOLS FOR SMART GRID	Classes: 9

Voltage stability analysis tools voltage stability assessment techniques, voltage stability indexing application and implementation plan of voltage stability in smart grid, angle stability assessment in smart grid approach of smart grid to state estimation, energy management in smart grid.

UNIT - V	**RENEWABLE ENERGY AND STORAGE**	**Classes: 9**

Renewable energy resources sustainable energy options for the smart grid penetration and variability issues associated with sustainable energy technology demand response issues electric vehicles and plug-in hybrids, plug in hybrid electric vehicles (PHEV), technology environmental implications, storage technologies, grid integration issues of renewable energy sources.

Text Books:

1. James Momoh, "Smart Grid: Fundamentals of design and analysis", John Wiley & sons Inc, 2nd Edition, 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & sons inc,1st Edition, 2012.
3. FereidoonPSioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press, 2nd Edition, 2012.

Reference Books:

1. Clark WGellings, "The smart grid: Enabling energy efficiency and demand response", Fairmont Press Inc, 2nd Edition, 2009.

Web References:

1. https://www.researchgate.net
2. https://www.aar.faculty.asu.edu/classes
3. https://www.facstaff.bucknell.edu/
4. https://www.electrical4u.com
5. https://www.crectirupati.com

E-Text Books:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com

Course Outcomes:

The student should have learnt about:

1. How to meet the standards for information exchange and for smart metering
2. How to preserve data and Communication security by adopting encryption and decryption procedures.
3. Monitoring, operating, and managing the transmission and distribution tasks under smart grid environment

4. Develop proficiency in stability analysis tools for smart grids, showcasing the ability to employ analytical techniques for ensuring stability.
5. Master the integration of renewable energy and storage in smart grids, demonstrating the ability to optimize and manage sustainable energy sources.

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	2	1	3		2						3	3
CO 2	3	1	1	2	3		2						3	3
CO 3	3	2	1	1	3		3						3	3
CO4	3	2	2	2	3		2						3	3
CO5	3	2	2	3	2		3						3	3
AVG	3	1.6	1.3	1.3	2.8		2.4						3	3

ENERGY AUDIT AND MANAGEMENT

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0217	PROFESSIONAL ELECTIVE	3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0	Practical Classes: Nil			Total Classes: 48			

OBJECTIVES:

The course should enable the students to:

I. Outline the principles and objectives of energy management.
II. Illustrate the techniques, procedures, evaluation and energy audit reporting.
III. Devise energy policy planning and implementation.
IV. Analyses energy balance sheet and management information System.

UNIT-I	INTRODUCTION TO ENERGY AUDIT	Classes: 10

Energy situation-World and India, Energy Consumption, Conservation, Codes, Standards and Legislation. Energy Audit-Definitions, Concept, Types of Audit, Energy Index, Cost Index, Pie Charts, Sankey Diagrams, Load Profiles, Energy Conservation Schemes. Measurements in Energy Audits, Presentation of Energy Audit Results.

UNIT - II	ENERGY EFFICIENT MOTORS AND POWER FACTOR IMPROVEMENT	Classes: 10

Energy Efficient Motors, Factors Affecting Efficiency, Loss Distribution, Constructional Details, Characteristics – Variable Speed, Variable Duty Cycle Systems, RMS Hp, - Voltage Variation – Voltage Unbalance – Over Motoring-Motor Energy Audit. Power Factor-Methods of Improvement, Power factor with Non Linear Loads.

UNIT - III	ENERGY AUDIT INSTRUMENTS	Classes: 10

Instruments: Instruments for audit and monitoring energy and energy savings, types and accuracy.

UNIT - IV	ENERGY BALANCE AND MIS	Classes: 9

Energy balance: First law of efficiency and second law of efficiency, facility as an energy system, methods for preparing process flow, materials and energy balance diagram, identification of losses, improvements.

MIS: Energy balance sheet and management information system (MIS) energy modeling

and optimization.

UNIT - V	DEMAND SIDE MANAGEMENT	Classes: 9

Introduction to DSM, Concept of DSM, Benefits of DSM, Different Techniques of DSM-Time of Day Pricing, Multi-Utility Power Exchange Model, Time of Day Models for planning. Load Management, Load Priority Technique, Peak Clipping, Peak Shifting, Valley Filling, Strategic Conservation, Energy Efficient Equipment. Management and Organization of Energy Conservation Awareness Programs.

Text Books:

1. W R Murphy, GMckay, "Energy Management", Butterworth's, 2nd Edition, 2009.
2. CBSmith,"Energy Management Principles", Pergamum Press, 2nd Edition, 1981.
3. I G C Dryden, "Efficient Use of Energy" , Butterworth's, 1st Edition, 1982.
4. AV Desai, "Energy Economics" ,Wiley Eastern, 1st Edition, 1991.

Reference Books:

1. DA Reay, "Industrial Energy Conservation", Pergamum Press, 1st Edition, 1977.
2. W C Turner, , " Energy Management Handbook, John Wiley and Sons, 6th Edition , 2006.
3. L C Witte, P S Schmidt, D R Brown, "Industrial Energy Management and Utilization",. Hemisphere Publication, Washington, 1st Edition, 1988.

Course Outcomes:

At the end of the course a student will be able to:

1. Conduct energy auditing and evaluate energy audit results
2. Analyze the losses of energy efficient motors for improvement of efficiency and power factor.
3. Understand and analyze the accuracy of various Instruments for energy audit and its monitoring for better energy savings.
4. Analyze energy balance sheet and management information System through case study.
5. Understand the concept of Demand Side management and analyze Different Techniques of DSM

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	2	2		3						3	3
CO 2	3	1	2	2	2		3						3	3
CO 3	3	2	2	2	3		2						3	3
CO 4	3	1	3	2	2		3						3	3
CO 5	3	2	2	2	2		3						3	3
AVG	3	2.6	2	2									3	3

DIGITAL IMAGE PROCESSING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PE0413	PROFESSIONAL ELECTIVE	3	0	0	3	40	60	100
Contact Classes:48	Tutorial Classes:Nil	Practical Classes: Nil				Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

- To Perform image manipulations and different digital image processing techniques
- To illustrate basic operations like – Enhancement, segmentation, compression, Image transforms and restoration techniques on image.
- To analyze pseudo and full color image processing techniques.
- To Apply various morphological operators on images

UNIT-I	INTRODUCTION	Classes:

IMAGE FUNDAMENTALS: Fundamental steps in Image Processing, Image sampling & quantization, some basic relationships between pixels, Arithmetic operations, Logical operations, Spatial operations,

IMAGE TRANSFORMS: 2D-DFT, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar-Transform, Slant Transform and KL Transform, properties of image transforms.

UNIT-II	IMAGE ENHANCEMENT:	Classes: 10

Basic Intensity transformation functions, Histogram processing, Fundamentals of Spatial Filtering, Smoothing spatial filters, Sharpening spatial filters, Combining spatial Enhancement methods.

Basics of filtering in frequency domain, Correspondence between filtering in the spatial and frequency domains, Image smoothing using frequency domain filters, Image sharpening using frequency domain filters, Homomorphic filtering.

UNIT-III	IMAGE RESTORATION	Classes: 10

Image degradation/Restoration model, Noise models, Restoration in the presence of Noise only-spatial filtering - mean, order- statistic and adaptive filters. Estimating the degradation function, Inverse filtering, Weiner filtering, Constrained least squares filtering.

UNIT-IV	IMAGE COMPRESSION	Classes: 9
Classification of redundancy in Images, Image Compression models, Run length coding, Arithmetic coding, Dictionary based compression, bit-plane coding, Transform based coding, Fidelity Criteria, JPEG 2000.		
UNIT-V	**IMAGE SEGMENTATION AND COLOR IMAGE PROCESSING**	**Classes: 09**
Detection of discontinuities- Point, line and edge Detection. Thresholding- global thresholding, adaptive thresholding. Region based Segmentation. Color image fundamentals - RGB, HSI models, conversions, Pseudo Color Image Processing, Color transformations.		

Text Books:

1. Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, Pearson Education, 4 th Edition, 2018.
2. Anil K.Jain, Fundamentals of Digital Image processing, Prentice Hall, 2007.

REFERENCE BOOKS:

1. S Jayaraman, S Esakkirajan, T Veerakumar, Digital Image Processing, Tata McGraw Hill Education, Second Edition, 2020.
2. Vipula Singh, Digital Image Processing with MATLAB & LabVIEW, Elsevier, 2019.

COURSE OUTCOMES:

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

- CO1: Apply various transformations on images by analyzing basic operations on images.
- CO2: Apply various image enhancement techniques in spatial and frequency domains.
- CO3: Apply restoration techniques based on noise models and degradation function to restore the images, pertaining to health and societal applications.
- CO4: Analyze various coding techniques for compression to reduce redundancies in images.
- CO5: Analyze various segmentation techniques on images for societal applications and Analyze various color models for different types of images.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	2		2	3	-	-	-	-	-	-	-	3	3
CO 2	3	2	2	2	3	-	-	-	-	-	-	-	3	3
CO 3	3	2		2	3	2	2	-	-	-	-	-	3	3
CO	3	3	2	2	2	2	2	2	-	-	-	-	3	3

4														
CO 5	3	3	2	2	2	2	2	-	-	-	-	-	3	3
AV G	3	2.4	2	2	2	2	2	2	-	-	-	-	3	3

SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. | www.svpcet.org

ELECTRICAL AND HYBRID VEHICLES

Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
20PE0218	**PROFESSIONAL ELECTIVE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes:48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		

OBJECTIVES:

The course should enable the students :

- To understand upcoming technology of hybrid system
- To understand different aspects of drives application
- Learning the electric Traction

UNIT-I	**HISTORY OF HYBRID AND ELECTRIC VEHICLES**	**Classes:**

Social and environmental importance of hybrid and electric vehicles Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterization, Transmission characteristics, mathematical models to describe vehicle performance.

UNIT-II	**BASIC CONCEPT OF HYBRID TRACTION**	**Classes: 10**

Introduction to various hybrid drive-train topologies Power flow control in hybrid drive-train topologies Fuel efficiency analysis. Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies Power flow control in hybrid drive-train topologies Fuel efficiency analysis.

UNIT-III	**ELECTRIC COMPONENTS**	**Classes: 10**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives , configuration and control of Permanent Magnet Motor drives, Configuration and control

of Switch Reluctance, Motor drives, drive system efficiency

UNIT-IV	INTERNAL COMBUSTION ENGINE	Classes: 10
Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology communications, supporting subsystems		
UNIT-V	**ENERGY MANAGEMENT**	**Classes: 09**
Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies		

Reference Books:

1. Sire -Ramirez, R. Silva Ortigoza, "Control Design Techniques in Power Electronics Devices", Springer.
2. Sinew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters"

Course Outcomes:

1. Students will understand the importance of hybrid and electric vehicles socially and environmentally and analyze their impact on energy supplies.
2. Students will learn about various hybrid drive-train setups, control power flow, and evaluate fuel efficiency.
3. Students will gain proficiency in configuring and controlling electric components like DC motors and assessing drive system efficiency.
4. Students will be able to match electric machines with internal combustion engines, select energy storage technologies, and understand supporting subsystems.
5. Students will comprehend energy management strategies, compare their effectiveness, and analyze implementation issues.

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	2	1									3	3
CO 2	3	1	2	1									3	3
CO3	3												3	3
CO4	3												3	3
CO5	3												3	3
AVG	3	1	2	1									3	3

SIMULATION LABORATORY - I

Course Code	Category	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0222	PROFESSIONAL CORE	-	-	3	1.5	40	60	100
Contact Classes: Nil	Tutorial Classes:00	Practical Classes: 48				Total Classes: 48		

OBJECTIVES:

- To present a problem oriented knowledge of power system analysis methods.
- To address the underlying concepts & approaches behind analysis of power system network using software tools.
- To identify & formulate solutions to problems relevant to power system using software tools

LIST OF EXPERIMENTS

WEEK – 1	Formation of Bus Admittance and Impedance Matrices and Solution of Networks
WEEK-2	Load Flow Analysis - I : Solution of Load Flow And Related Problems Using Gauss-Seidel Method
WEEK-3	Load Flow Analysis - II: Solution of Load Flow and Related Problems Using Newton-Raphson and Fast-Decoupled Methods
WEEK -4	Load flow analysis of a given power system with STATCOM
WEEK -5	Fault Analysis(LG, LLG, LLLG & LLL Faults)
WEEK -6	Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
WEEK -7	Transient Stability Analysis of Multi machine Power Systems
WEEK -8	Transient analysis of single machine infinite bus system with STATCOM
WEEK-9	Electromagnetic Transients in Power Systems
WEEK-10	Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
WEEK-11	Economic Dispatch in Power Systems.

Reference Books:

1.A.K.Ray&K.M.Bhurchandi "Advanced Microprocessor and Peripherals", 2nd Edition TMH,2012
2.MSP430 microcontroller basics. John H. Davies, Newnes Publication, 1st Edition, 2008.

Web References:

1.http://www.nptel.ac.in/downloads/106108100
2.http://www.the8051microcontroller.com/web-references

Outcomes: After completion of course the student can able to

1. Simulate the concepts & approaches behind analysis of power system network matrices

using MATLAB/Simulink.

2. Simulate the methods of load flow analysis using MATLAB/Simulink.
3. To formulate solutions to problems relevant to power system using software tools using MATLAB/Simulink.
4. Simulate the methods of fault analysis using MATLAB/Simulink.
5. Simulate the methods of transient stability analysis using MATLAB/Simulink.

CO-PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	3	3	1	1		2	2				
CO 2	3	3	2	3	3	2	1		2	2				
CO 3	3	3	2	3	3	2	2		2	2				
CO 4	3	3	3	2	2	1	1		1	2				
CO 5	3	3	3	2	2	1	1		1	2				
AVG	3	3	2.4	2.6	2.6	1.4	1.2		1.6	2				

SIMULATION LABORATORY - II

Course Code	Category	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20PC0223	PROFESSIONAL CORE	-	-	3	1.5	40	60	100
Contact Classes: Nil	Tutorial Classes:	Practical Classes: 48				Total Classes: 48		

OBJECTIVES:

- To present a problem oriented knowledge of power system analysis methods.
- To address the underlying concepts & approaches behind analysis of power system network using software tools.
- To identify & formulate solutions to problems relevant to power system using software tools.

LIST OF EXPERIMENTS

WEEK – 1	Formation of y- bus using singular transformation method with and without mutual coupling Formation of 'Y- BUS' by inspection method
WEEK-2	Z-bus building algorithm
WEEK-3	Determination of power angle curve for non- salient pole synchronous machines
WEEK -4	Determination of power angle curve salient pole synchronous machines
WEEK -5	Program for swing curve when the fault is cleared
WEEK -6	Swing curve for sustained fault and critical clearing angle & time
WEEK -7	Formation of jacobian for the system not exceeding 4 buses (no pv buses) in polar coordinates
WEEK -8	Determination of bus currents, bus power & line flows for a specified system voltage (bus) profile
WEEK-9	Formation for symmetric π /T configuration for Verification of $AD-BC=1$, Determination of Efficiency and Regulation.
WEEK-10	Formation of Jacobian for a System not Exceeding 4 Buses (No PV Buses) in Polar Coordinates

Reference Books:

1.A.K.Ray&K.M.Bhurchandi "Advanced Microprocessor and Peripherals", 2nd Edition TMH,2012
2. MSP430 microcontroller basics. John H. Davies, Newnes Publication, 1st Edition, 2008.

Web References:
1.http://www.nptel.ac.in/downloads/106108100 2.http://www.the8051microcontroller.com/web-references
Outcomes: After completion of course the student can able to • Simulate the concepts & approaches behind analysis of power system network matrices using MATLAB/Simulink. • Simulate the methods of swing curve using MATLAB/Simulink. • Simulate the methods of salient pole synchronous machines using MATLAB/Simulink • To formulate solutions to problems relevant to power system using MATLAB/Simulink

CO-PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	3	3	1	1		2	2				
CO 2	3	3	2	3	3	2	1		2	2				
CO 3	3	3	2	3	3	2	2		2	2				
CO 4														
CO 5														
AVG	3	3	2	3	3	1.6	1.3		2	2				

RENEWABLE ENERGY SOURCES

V Semester: Common for all Branches								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
20OE0201	**OPEN ELECTIVE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		

OBJECTIVES:

The course should enable the students to:

It introduces solar energy its radiation, collection, storage and application. It also introduces the Wind energy, Biomass energy, Geothermal energy and ocean energy as alternative energy sources.

UNIT-I	**PRINCIPLES OF SOLAR RADIATION**	**Classes: 10**

PRINCIPLES OF SOLAR RADIATION: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors

UNIT-II	**SOLAR ENERGY STORAGE AND APPLICATIONS & WIND ENERGY**	**Classes: 10**

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and
drying, photovoltaic energy conversion.

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

UNIT-III	**BIO-MASS**	**Classes: 10**

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation And economic aspects.

UNIT-IV	GEOTHERMAL ENERGY & OCEAN ENERGY	Classes: 09
GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.		
UNIT-V	**DIRECT ENERGY CONVERSION**	**Classes: 09**
Need for DEC, Carnot cycle, limitations, principles of DEC.		
Text Books:		
1. Non-Conventional Energy Sources by G.D. Rai, Khanna Publishers 2. Renewable Energy Resources – Twidell& Wier, CRC Press(Taylor & Francis)		
Reference Books:		
1. Renewable energy resources by Tiwari and Ghosal, Narosa. 2. Renewable Energy Technologies by Ramesh & Kumar, Narosa. 3. Non-Conventional Energy Systems by K Mittal, Wheeler 4. Renewable energy sources and emerging technologies byD.P.Kothari,K.C.Singhal, PHI1.		
Course Outcomes:At the end of the course, a student will be able to: 1. Understand the Electric power generation from renewable energy sources as sun, wind and ocean. 2. Analyze the generation principles and operation of variety of sources of energy 3. Understand Bio-Conversion of energy storage and economy 4. Analyze Geothermal Energy & Ocean Energy 5. Understand the necessity and principles of direct energy conversions.		

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	2	1										
CO 2	3	1	1	1										
CO 3	3	1	2	1										
CO 4	3	1	1	1										
CO 5	3	1	1	1										
AVG	3	1	1.4	1										

INTRODUCTION TO POWER ELECTRONICS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20OE0202	OPEN ELECTIVE	3	0	0	3	40	60	100
Contact Classes:48	Tutorial Classes: 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

The objectives of the course are to make the student learn about

- the basic power semiconductor switching devices and their principles of operation.
- the various power conversion methods, controlling and designing of power converters.
- the applications of Power electronic conversion to domestic, industrial, aerospace, commercial and utility systems etc.
- the equipment used for DC to AC, AC to DC, DC to Variable DC, and AC to Variable frequency AC conversions.

UNIT-I	POWER SEMI CONDUCTOR DEVICES	Classes:14

Semiconductor Power Diodes, Classification of Switching Devices Based on Frequency and Power Handling Capacity-BJT – Power Transistor - Power MOSFET – Power IGBT - Thyristors – Silicon Controlled Rectifiers (SCR's) – Basic Theory of Operation of SCR – Static Characteristics – Turn On and Turn Off Methods- Dynamic Characteristics of SCR - Two Transistor Analogy – Triggering Circuits– Snubber Circuits.

UNIT - II	PHASE CONTROLLED CONVERTERS	Classes:14

Phase Control Technique – Single Phase Line Commutated Converters – Mid Point and Bridge Connections – Half Controlled Converters, Fully Controlled Converters with Resistive, RL Loads and RLE Load– Derivation of Average Load Voltage and Current – Active and Reactive Power Inputs to the Converters without and with Free-Wheeling Diode, Effect of Source Inductance – Numerical Problems. Three Phase Line Commutated Converters – Three Pulse Converters – Mid Point and Bridge Connections - Average Load Voltage with R and RL Loads – Effect of Source Inductance.

UNIT – III	CHOPPERS AND REGULATORS	Classes:13
Commutation Circuits – Time Ratio Control and Current Limit Control Strategies – Step Down and Step-up Choppers Derivation of Load Voltage and Currents with R, RL and RLE Loads- Step Up Chopper – Load Voltage Expression– Problems. Study of Buck, Boost and Buck-Boost regulators.		
UNIT - IV	**INVERTERS**	**Classes:13**
Inverters – Single Phase Inverter – Basic Series Inverter – Basic Parallel Capacitor Inverter Bridge Inverter – Waveforms – Simple Forced Commutation Circuits for Bridge Inverters – Single Phase Half and Full Bridge Inverters-Pulse Width Modulation Control-Harmonic Reduction Techniques-Voltage Control Techniques for Inverters – Numerical Problems, Three Phase VSI in 120^0 Mode of Conduction.		
UNIT - V	**AC VOLTAGE CONTROLLERS & CYCLO CONVERTERS**	**Classes:14**
AC Voltage Controllers – Single Phase Two SCR's in Anti Parallel – With R and RL Loads – Modes of Operation of TRIAC – TRIAC with R and RL Loads – Derivation of RMS Load Voltage, Current and Power Factor Wave Forms – Firing Circuits - Numerical Problems - Thyristor Controlled Reactors; Switched Capacitor Networks. **Cyclo Converters** – Single Phase Mid Point Cycloconverters with Resistive and Inductive Load (Principle of Operation only) – Bridge Configuration of Single Phase Cycloconverter (Principle of Operation only) – Waveforms		

Text Books:

1. Power Electronics, M. D. Singh and K. B. Khanchandani, Mc Graw Hill Education (India) Pvt. Ltd., 2nd Edition, 2007, 23rd Reprint 2015.
2. Power Electronics: Circuits, Devices and Applications, Muhammad H. Rashid, Pearson, 3rd Edition, 2014, 2nd Impression 2015.

Reference Books:

1. Power Electronics, K. R. Varmah, Chikku Abraham, CENGAGE Learning, 1st Edition, 2016.
2. Power Electronics, P. S. Bimbhra, Khanna Publishers, 2012.
3. Power Electronics: Devices, Circuits, and Industrial Applications, V. R. Moorthi, OXFORD University Press, 1st Edition, 2005, 12th Impression 2012.

Course Outcome:

After going through this course, the student acquires knowledge about:

- Basic operating principles of power semiconductor switching devices.
- Understand operation and analysis of power electronic converter circuits.
- Analyze operation and analysis of choppers and regulator circuits.
- Understand operation and analysis of inverter circuits.

- Understand operation and analysis of AC voltage controllers, and cycloconverters and their control.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	3		1	1					1		
CO 2	3	2	3	3		2	1					1		
CO 3	2	1	1	1		1	1					1		
CO 4	3													
CO 5	3													
AV G	2. 6	1. 6	2	2.3		1.3	1					1		

SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. | www.svpcet.org

ELECTRICAL POWER GENERATION SYSTEMS

Course Code	Category	Hours /Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20OE0203	OPEN ELECTIVE	3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes:0	Practical Classes: Nil				TotalClasses:48		

OBJECTIVES:

Students will try to learn:

The fundamental concepts of power generation and gain knowledge about the different renewable and non-renewable energy sources.

The construction and working principle of thermal, hydro-electric, nuclear and gas power plants.

The key aspects in solar , wind, bio gas and geo thermal power energy systems and analyze their environmental aspects in the present-day scenario to obtain clean energy.

UNIT-I:	THERMAL & HYDRO POWER GENERATING SYSTEMS	

Thermal Power Generating Systems:

Block Diagram of Thermal Power Station (TPS) showing paths of Coal, Steam, Water, Air, Ash and Flue Gasses - Brief Description of TPS Components: Economizers, Boilers, Super Heaters, Turbines, Condensers, Chimney and Cooling Towers.

Hydro Power Generating Systems: Selection of Site, Classification, Layout, Description of Main Components.

UNIT-II	NUCLEAR POWER GENERATING SYSTEMS	

Nuclear Power: Nuclear Fission and Chain Reaction.- Nuclear Fuels.- Principle of Operation of Nuclear Reactor.-Reactor Components: Moderators, Control Rods, Reflectors and Coolants.- Radiation Hazards: Shielding and Safety Precautions.- Types of Nuclear Reactors and Brief Description of PWR, BWR and FBR.

UNIT –III	SOLAR & WIND POWER GENERATING SYSTEMS	

Solar Power Generation: Role and Potential of Solar Energy Options, Principles of Solar Radiation, Flat Plate and Concentrating Solar Energy Collectors, Different Methods of Energy Storage – PV Cell- V-I Characteristics.

Wind Power Generation: Role and potential of Wind Energy Option, Horizontal and Vertical Axis Wind Mills- Performance Characteristics- Power- Speed & Torque- Speed Characteristics.

UNIT-IV	BIOGAS POWER GENERATING SYSTEMS	

Biogas Power Generation: Principles of Bioconversion, Types of Biogas Digesters – Characteristics of Bio-Gas- Utilization- Economic and Environmental Aspects.

UNIT-V	GEOTHERMAL POWER GENERATING SYSTEMS	

Geothermal and Ocean Power Generation: Principle of Geothermal Energy Methods of Harnessing-Principle of Ocean Energy-Tidal and Wave Energy- Mini Hydel Plants- Economic Aspects.

TEXT BOOKS:

1. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A.Chakraborti, Dhanpat Rai & Co. Pvt. Ltd., 1999.

2.Principles of Power Systems by V.K Mehta and Rohit Mehta S.CHAND& COMPANY LTD., New Delhi 2004.

REFERENCE BOOKS :

1. Electric Power Generation Distribution and Utilization by C.L Wadhwa, New Age International (P) Ltd., 2005.
2. Non Conventional Energy Sources by G.D. Rai, Khanna Publishers, 2000.

COURSE OUTCOMES: Upon successful completion of the course, students should be able to

1. Understand the Thermal & Hydro Power Generating Systems.
2. Analyze the generation principles and operation of Solar & Wind Power Generating Systems.
3. Understand Bio-Conversion of energy storage and economy
4. Analyze Biogas Power Generating Systems.
5. Understand the necessity Geothermal Energy & Ocean Energy.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1		1										
CO 2	3	2	1	1										
CO 3	3	1	1	2										
CO 4	3	3	1	1										
CO 5	3	2	2	2										
AVG	3	1.8	1.2	1.4										

INTRODUCTION TO HIGH VOLTAGE ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20OE0204	OPEN ELECTIVE	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

To impart knowledge on the following Topics

- Various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination

UNIT-I	**OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS**	**Classes: 10**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages, Corona and its effects – Bewley lattice diagram- Protection against over voltages.

UNIT-II	**DIELECTRIC BREAKDOWN**	**Classes: 10**

Properties of Dielectric materials - Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics- Applications of insulating materials.

UNIT-III	**GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS**	**Classes: 10**

Generation of High DC voltage: Rectifiers, voltage multipliers, vandigraff generator: generation of high impulse voltage: single and multistage Marx circuits – generation of high AC voltages: cascaded transformers, resonant transformer and tesla coil- generation of switching surges – generation of impulse currents - Triggering and control of impulse generators.

UNIT-IV	**MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS**	**Classes: 9**

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

UNIT-V	**HIGH VOLTAGE TESTING & INSULATION COORDINATION**	**Classes: 9**

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination & testing .

Text Books:

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier , New Delhi, 2005.
3. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Third Edition, 2010.

Reference Books:

1. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
2. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, Roshday Radwan, High Voltage Engineering – Theory &Practice, Second Edition Marcel Dekker, Inc., 2010.
3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.

Course Outcome:

At the end of course the student is able to

1. understand various types of over voltages and to measure over voltages in power system.
2. Analyze the properties of Dielectric materials and its break down.
3. understand Generation, measurement and testing of high voltage.
4. Proficiently conduct measurements of high voltage and high current, demonstrating the ability to employ accurate techniques and instruments for precise analysis in electrical systems.
5. Develop expertise in high voltage testing and insulation coordination, ensuring effective tests and optimal insulation design for enhanced electrical system reliability.

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2		1										
CO 2	3	2	1	1										
CO 3	3	3	2	2										
CO 4	3	3	2	2										
CO 5	3	3	2	2										
AVG	3	2.6	1.7	1.6										

ELECTRICAL POWER QUALITY

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20OE0205	OPEN ELECTIVE	2	2	-	3	30	70	100
Contact Classes: 48	Tutorial Classes: 0		Practical Classes: 0			Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

V. Understand the terminology used to describe power quality.

VI. The sources of power quality disturbances and power transients that occur in power systems.

VII. The sources of harmonics, harmonic indices, Devices for controlling harmonic distortion.

VIII. The principle of operation of DVR and UPQC.

UNIT-I	INTRODUCTION	Classes:10

Introduction of the power quality (PQ) problem, terms used in PQ: Voltage, sag, swell, surges, harmonics, over voltages, spikes, voltage fluctuations, transients, interruption, overview of power quality phenomenon, remedies to improve power quality, power quality monitoring.

Classes:10	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.

UNIT - III	FUNDAMENTALS OF HARMONICS & APPLIED HARMONICS	Classes:9

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.

UNIT - IV	POWER QUALITY MONITORING	Classes:9

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- Power Quality Monitoring Standards.

UNIT - V	POWER QUALITY ENHANCEMENT USING CUSTOM POWER DEVICES	Classes:10

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.
Text Books:
1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, 2. H.Wayne Beaty, Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition, 2012. 3. Power quality, C. Sankaran, CRC Press, 2001.
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 Outcome: At the end of the course, a student will be able to: CO1: To study various methods of power quality monitoring. CO2: To Study the production of voltages sags. CO3: To Study the interruptions types and its influence in various components. CO4: To Study the Effects of harmonics on various equipment's. CO5: Understand power quality monitoring and classification techniques.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2								1		
CO2	3	2	2	1								1		
CO3	3	3	1	2								1		
CO4	3	2	1	1								1		
CO5	3	1	2	3								1		
AVG	3	2	1.4	1.8								1		

ELECTRICAL TRANSMISSION SYSTEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20OE0206	OPEN ELECTIVE	3	0	0	3	40	60	100
Contact Classes:	Tutorial Classes:		Practical Classes:			Total Classes:		

OBJECTIVES:

The objectives of the course are to make the student learn about

- Classification of transmission lines and representation by suitable equivalent circuits
- The calculation of performance of transmission lines.
- The analysis of mechanical design, sag of transmission line.
- The underground cables its comparison with overhead lines and substations.

UNIT-I	TRANSMISSION LINE PARAMETERS	Classes:10

Inductance & Capacitance Calculations of Transmission Lines: Line conductors, inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing, Composite conductors-transposition, bundled conductors, and effect of earth on capacitance. Numerical Problems.

UNIT - II	MODELLING AND PERFORMANCE OF TRANSMISSION LINES	Classes:10

Classification of transmission lines: Short, medium and long line and their model representations, nominal T, nominal π and A, B, C, D constants for symmetrical and asymmetrical networks, numerical problems, mathematical solutions to estimate regulation and efficiency of all types of lines, numerical problems; Long transmission line: Rigorous solution, evaluation of A, B, C, D constants, numerical problems, Ferranti effect, surge impedance and surge impedance loading of long lines. Incident, reflected and refracted waves, wave length and velocity of propagation of waves.

UNIT - III	MECHANICAL DESIGN OF TRANSMISSION LINES	Classes:10

Overhead Line Insulators: Types of Insulators, String Efficiency and Methods for Improvement, Capacitance Grading and Static Shielding.

Corona: Corona Phenomenon, Factors Affecting Corona, Critical Voltages and Power Loss, Radio Interference.

UNIT - IV	UNDER GROUND CABLES	Classes:09

Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables.

UNIT - V	SAG AND SUBSTATIONS	Classes:09

Sag and tension calculations: Sag and tension calculations with equal and unequal heights of towers, effect of wind and ice on weight of conductor, numerical problems, stringing chart and sag template and its applications.

Substation: Classification of substations, substation equipments, bus bar arrangement and bus-bar schemes.

Text Books:

1. Electrical power systems, C.L.Wadhwa, New Age International (P) Limited, 6th Edition, 2010, Reprint 2014.
2. A Text Book on Power System Engineering, M.L.Soni, J.B.Gupta, U.S.Bhatnagar and A.Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd., 1999.
3. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, TMH Publications, 2011.
4. Switchgear and Protection, Sunil S Rao, Khanna Publishers, 1992.

Reference Books:

1. Power system Analysis 4th edition, John J Grainger and William D Stevenson, JR, Mc Graw Hill Education, 2003, Reprint 2015.
2. Power System Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill Education (India) Pvt. Ltd., 2nd Edition, 2008, 23rd Reprint 2015.
3. Electric Power Transmission System Engineering: Analysis and Design, TuranGonen, 2nd Edition, CRC Press, Taylor & Francis group, 2009, 1st Indian Reprint 2010
4. Transmission network Protection, Y.G. Paithankar ,Taylor and Francis,2009.
5. Power system protection and switch gear, BhuvaneshOza, TMH, 2010.

Course Outcome:

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

CO1: analyze and model transmission line and can determine the performance of line.

CO2:Analyze Classification of transmission lines and loading effect in transmission lines.

CO3: analyze the mechanical design of transmission line and grounding.

CO4: analyze the grading of underground cables and comparison with overhead lines.

CO5:calculate sag of transmission line and different types of substations

CO-PO MAPPING

(COs)	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO10	PO11	PO1 2	PSO1	PSO2
CO1	3	3	1	1										
CO2	3	2	2	1										
CO3	3	2	2	2										
CO4	3	3	3	2										
CO5	3	2	1	2										
AV G	3	2. 4	1.8	1.6										

INTRODUCTION TO ELECTRICAL DRIVES

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20OE0207	OPEN ELECTIVE	3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0		Practical Classes: Nil			Total Classes: 48		

OBJECTIVES:

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of dc motors and induction motors.
2. Understand the principles of speed-control of dc motors and induction motors.
3. Understand the power electronic converters used for dc motor and induction motor speed control.

UNIT-I	CONVERTER FED DC MOTORS	Classes: 10

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.

UNIT - II	FOUR QUADRANT OPERATION OF DC DRIVES	Classes: 10

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)

UNIT - III	CHOPPER FED DC MOTORS	Classes: 10

Single Quadrant, Two Quadrant and Four Quadrant Chopper Fed DC Separately Excited Excited Motors – Continuous Current Operation – Output Voltage and Current Wave Forms – Speed Torque Expressions – Speed Torque Characteristics – Problems on Chopper Fed D.C Motors

UNIT - IV	CONTROL OF INDUCTION MOTOR	Classes: 09

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).

UNIT - V	**CONTROL OF SYNCHRONOUS MOTORS**	**Classes: 09**

Separate Control & Self Control of Synchronous Motors – Operation of Self Controlled Synchronous Motors by VSI and CSI Cycloconverters. 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).

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 Outcomes:

The student should be able to:

- Identify the choice of the electric drive system based on their applications
- Explain the operation of single and multi quadrant electric drives
- Analyze single phase and three phase rectifiers fed DC motors as well as chopper fed DC motors
- Explain the speed control methods for AC-AC & DC-AC converters fed to Induction motors and
- Understand Synchronous motors with closed loop, and open loop operations

CO-PO MAPPING

	PO1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	3	2										
CO 2	3	1	1	2										
CO 3	3	2	2	2										
CO4	3	2	3	2										

CO5	3	1	1	2										
AVG	3	1.6	2	2										

SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. I www.svpcet.org

DISTRIBUTED SYSTEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20OE0208	OPEN ELECTIVE	3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes:00	Practical Classes: 00				Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

To study different factors of Distribution system.

- To study and design the substations and distribution systems.
- To study the concepts of voltage drop and power loss.
- To study the distribution system protection and its coordination.
- To study the effect of compensation for power factor improvement.
- To study the effect of voltage control on distribution system.

UNIT-I	GENERAL CONCEPTS	Classes:10

Introduction to distribution systems – Distribution system losses – Coincidence factor –Contribution factor loss factor – Numerical Problems – Load Modelling and Characteristics – Relationship between the load factor and loss factor – Classification and characteristics of loads (Residential, commercial, Agricultural and Industrial).

UNIT - II	SUBSTATIONS	Classes:10

Location of substations: Rating of distribution substation – Service area with 'n' primary feeders – Benefits and methods of optimal location of substations..

Distribution Feeders

Design Considerations of distribution feeders: Radial and loop types of primary feeders – Voltage levels – Feeder loading – Basic design practice of the secondary distribution system.

UNIT - III	SYSTEM ANALYSIS	Classes:09

Voltage drop and power–loss calculations: Derivation for voltage drop and power loss in lines – Uniformly distributed loads and non-uniformly distributed loads – Numerical problems – Three phase balanced primary lines.

UNIT - IV	PROTECTION, COORDINATION & AUTOMATION	Classes:10

Objectives of distribution system protection –Time current characteristics – Protective devices: Principle of operation of fuses – Circuit Reclosures – Line sectionalizes and circuit breakers, Modulated case circuit breakers, Earth leakage circuit breakers – Protection schemes of parallel & Ring main feeders.

Coordination of protective devices: General coordination procedure –Various types of co-ordinated operation of protective devices – Residual Current Circuit Breaker Automation: Block diagram approach of SCADA.

UNIT - V	COMPENSATION FOR POWER FACTOR IMPROVEMENT	Classes:10

Capacitive compensation for power factor control – Different types of power capacitors – shunt and series capacitors – Effect of shunt capacitors (Fixed and switched) – Power factor correction – Capacitor allocation – Economic justification – Procedure to determine the best capacitor location – Numerical problems.

Voltage Control

Voltage Control: Equipment for voltage control – Effect of series capacitors – Effect of AVB/AVR – Line drop compensation – Numerical problems.

Text Books:

1. "Electric Power Distribution system, Engineering" – by Turan Gonen, McGraw–hill Book Company.

Reference Books:

1. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo, CRC press
2. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing company, 4th edition, 1997.
3. Electrical Power Distribution Systems by V.Kamaraju, Right Publishers.

Course Outcome:

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

1.Understand various factors of distribution system, design the substation and feeders.

2.Determine the voltage drop and power loss.

3.Understand the protection and its coordination.

4. understand the effect of compensation for p.f improvement and the effect of voltage control.

5.Understand the effect of compensation for p.f improvement and analysing the effect of voltage control

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO 9	PO10	PO1 1	PO12	PSO1	PSO2
CO1	3	3	3	2								1		
CO2	3	3	2	2								1		
CO3	3	3	1	1								1		
CO4	3	2	2	1								1		
CO5	3	2	2	1								1		
AV G	3	2.8	2. 4	1.4								1		

UTILIZATION AND TRACTION SYSTEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20OE0209	OPEN ELECTIVE	3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes: Nil		Practical Classes: Nil			Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

- To analyze the various concepts behind renewable energy resources.
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To introduce knowledge on Solar Radiation and Solar Energy Collectors.
- To introduce concepts of Wind Energy and its utilization.

UNIT-I	ILLUMINATION	Classes:10

Introduction - definition and meaning of terms used in illumination engineering, law of illumination - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.

UNIT-II	HEATING AND WELDING	Classes:10

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding, equipment used for arc welding.

UNIT-III	ELECTRIC TRACTION – I	Classes:09

Introduction – Systems of Electric Traction. Comparison Between A.C and D.C 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.

UNIT-IV	ELECTRIC TRACTION – II	Classes:10
Mechanics of Train Movement. Speed-Time Curves of Different Services – Trapezoidal and Quadrilateral, Speed-Time Curves – Numerical Problems. Calculations of Tractive Effort, Power, and Specific Energy Consumption - Effect of Varying Acceleration and Braking Retardation, Adhesive Weight and Coefficient of Adhesion –Problems.		
UNIT-V	**INTRODUCTION TO ELECTRIC AND HYBRID VEHICLES**	**Classes:09**
Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement, vehicle performance and energy consumption.		

Text Books:

1. N.V. Suryanarayana, "Utilisation of Electric Power", Wiley Eastern Limited, New Age
International Limited,1993.
2. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons, 2000.
3. G.D.Rai, "Non-Conventional Energy Sources", Khanna Publications Ltd., New Delhi, 1997.

Reference Books:

1. R.K.Rajput, Utilisation of Electric Power, Laxmi publications Private Limited.,2007.
2. H.Partab, Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New
Delhi, 2004.
3. C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age
International Pvt.Ltd., 2003.
4. S. Sivanagaraju, M. Balasubba Reddy, D. Srilatha,' Generation and Utilization of Electrical
Energy', Pearson Education, 2010.
5. Donals L. Steeby,' Alternative Energy Sources and Systems', Cengage Learning, 2012.

Course Outcomes:

At the end of the course a student will be able to:

1. Illustrate working principle electric power utilization and their application in real life
2. Choose proper traction systems depending upon application considering economic and technology up-gradation.
3. Employ mathematical and graphical analysis considering different practical issues to design of traction system; analyze the performance parameter of the

traction system.

4. Examine various applications in indoor and outdoor application areas where use of light sources are essential.
5. Classify types of electric light sources based on nature of operation and their objectives, performance and reliability.

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2										
CO 2	3	3	2	2										
CO 3	3	2	1	3										
CO4	3	2	2	2										
CO5	3	1	1	2										
AVG	3	2.2	1.8	2.2										

INTRODUCTION TO POWER SYSTEM PROTECTION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20OE0210	OPEN ELECTIVE	3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 48			

OBJECTIVES:

The course should enable the students to:

- The different types of electromagnetic relays and microprocessor-based relays
- The protection of Generators, Transformers and feeders.
- The technical aspects involved in the operation of circuit breakers
- The generation of over voltages and its mitigation,

UNIT - I	PROTECTIVE RELAYS	Classes:10

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 and their flowcharts.

UNIT -II	PROTECTION OF GENERATORS, TRANSFORMERS	Classes:10

Protection of generators against stator faults, Rotor faults and abnormal conditions. Restricted earth fault and inter-turn fault protection. Numerical problems on percentage winding unprotected. Protection of transformers: Percentage differential protection, Numerical problem on design of CT ratio, Buchholz relay protection, Numerical Problems.

UNIT - III	PROTECTION OF FEEDERS AND LINES	Classes:09

Protection of feeder (Radial and ring main) using over current relays. Protection of transmission line – 3 zone protection using distance relays. Carrier current protection. Protection of bus bars.

UNIT - IV	CIRCUIT BREAKERS	Classes:10

Elementary principles of arc interruption, Recovery, Restriking voltage and recovery voltage – Restriking phenomenon, Average and max. RRRV, Numerical problems – 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.

UNIT - V	OVER VOLTAGES IN POWER SYSTEMS	Classes:09

Generation of over voltages in power systems – Protection against lightning over voltages – Valve type and Zinc-Oxide lightning arresters – Insulation coordination – BIL.

Text Books:

1. Power System Protection and Switchgear Badri Ram, D.N. Vishwakarma McGraw Hill 2nd Edition
2. Power System Protection and Switchgear BhuvaneshOza et al McGraw Hill 1st Edition, 2010

Reference Books:

1. Protection and Switchgear Bhavesh et al Oxford 1 st Edition, 2011
2. Power System Switchgear and Protection N. Veerappan S.R. Krishnamurthy S. Chand 1 st Edition, 2009
3. Fundamentals of Power System Protection Y.G.Paithankar S.R. Bhide PHI 1 st Edition, 2009

Course Outcomes:

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

- Discuss performance of protective relays, components of protection scheme and relay terminology over current protection, distance relays, of differential relays etc
- Discuss protection of generators, motors, Transformer and Bus Zone Protection.
- Explain the principle of circuit interruption in different types of circuit breakers.
- Discuss protection against Over voltages
- Understand Protection against lightning over voltages

CO-PO MAPPING

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	2	1								1		

CO 2	3	3	3	2							1		
CO 3	3	1	2	2							1		
CO4	3	1	2	2									
CO5	3	2	1								1		
AVG	3	1.6	2	1.4							0.8		

POWER SYSTEM ANALYSIS AND OPERATION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20OE0211	OPEN ELECTIVE	3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0	Practical Classes: 0			Total Classes: 48			

OBJECTIVES:

The course should enable the students to:

1. Illustrate the formation of [Z] bus of a power system network.
2. Compute power flow studies by various numerical methods.
3. Discuss the symmetrical component theory, sequence networks and short circuit calculations.
4. Analyze power system for steady state stability
5. Analyze power system for Transient stability and suggest methods to improve.

UNIT - I	POWER SYSTEM NETWORK MATRICES	Classes: 10

Graph Theory: Fundamental Concepts and Definition, Development of bus incidence matrices.

Network Matrices: Formation **of** Y bus by singular transformation and direct inspection methods, numerical problems; Formation of Z Bus: Partial network, algorithm for the modification of Z bus matrix for addition of element from a new bus to reference bus, addition of element from a new bus to an old bus, addition of element between an old bus to reference bus and addition of element between two old busses (Derivations and Numerical Problems).

UNIT - II	POWER FLOW STUDIES AND LOAD FLOWS	Classes: 10

Load flows studies: Necessity of power flow studies, data for power flow studies,

derivation of static load flow equations; Load flow solutions using Gauss Seidel method: Acceleration factor, load flow solution with and without PV buses, algorithm and flowchart; Numerical load flow solution for simple power systems (Max. 3 buses): Determination of bus voltages, injected active and reactive powers (Sample one iteration only) and finding line flows / losses for the given bus voltages; Newton Raphson method in polar coordinates form: Load flow solution with or without PV busses derivation of Jacobian elements, algorithm and flowchart, decoupled and fast decoupled methods.

UNIT - III	**SHORT CIRCUIT ANALYSIS PER UNIT SYSTEM OF REPRESENTATION**	**Classes: 10**

Per unit system: Equivalent reactance network of a three-phase power system, numerical problems; Symmetrical fault analysis: short circuit current and MVA calculations, fault levels, application of series reactors, numerical problems; Symmetrical component theory: Symmetrical component transformation, positive, negative and zero sequence components, voltages, currents and impedances.

Sequence networks: Positive, negative and zero sequence networks, numerical problems; Unsymmetrical fault analysis: LG, LL, LLG faults with and without fault impedance, numerical problems.

UNIT - IV	**STEADY STATE STABILITY ANALYSIS**	**Classes: 9**

Steady state stability: Elementary concepts of steady state, dynamic and transient stabilities, description of steady state stability power limit, transfer reactance, synchronizing power coefficient, power angle curve and determination of steady state stability and methods to improve steady state stability.

UNIT - V	**TRANSIENT STATE STABILITY ANALYSIS**	**Classes: 9**

Swing equation: Derivation of swing equation, determination of transient stability by equal area criterion, application of equal area criterion, critical clearing angle calculation, solution of swing equation, point by point method, methods to improve stability, application of auto reclosing and fast operating circuit breakers.

Text Books:

1. I J Nagrath& D P Kothari, “Modern Power system Analysis”, Tata McGraw-Hill Publishing Company, 2nd Edition.
2. C L Wadhwa, “Electrical Power Systems”, Newage International, 3rd Edition.
3. M A Pai,“Computer Techniques in Power System Analysis”, TMH Publications.
4. N..Ramana “Power System Analysis”,Pearson Education India.

Reference Books:

1. K Umarao, “Computer techniques and models in power systems”, I K International Pvt. Ltd.
2. HadiSaadat, “Power System Analysis”, 2nd *Edition*, *TMH*. *Edition*, 2003.

3. Grainger and Stevenson, "Power System Analysis", Tata McGraw Hill.
4. J Duncan Glover and M S Sarma., THOMPSON, "Power System Analysis and Design", 3rd Edition.
5. Abhijit Chakrabarthi and SunitaHaldar, "Power system Analysis Operation and control", 3rd Edition, PHI, 2010.

Web References:

1. https://www.worldcat.org/title/computer-methods-in-power-system-analysis/.../600788826
2. https://www.sjbit.edu.in/.../COMPUTER%20%20TECHNIQUES%20IN%20POWER%20%20SYS..
3. https://www.books.google.com › Technology & Engineering › Electrical
4. https://www. nptel.ac.in/courses/108105067/
5. https://www.jntusyllabus.blogspot.com/2012/01/computer-methods-power-systems-syllabus.html

E-Text Books:

1. https://www.scribd.com/.../Computer-Methods-in-Power-System-Analysis-by-G-W-St...
2. https://www.academia.edu/8352160/Computer_Methods_and_Power_System_Analysis_Stagg
3. https://www.uploady.com/#!/download/ddC9obmVTiv/NwO1AnQrlmogeJjS
4. https://www.materialdownload.in/article/Computer-Methods-in-Power-System-Analysis_159/
5. https://www.ee.iitm.ac.in/2015/07/ee5253/

Course Outcome:

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

1. Find [Z] bus and [Y] bus of a power system network
2. Analyze load flow studies(different algorithms, flow charts)
3. Analyze the symmetrical and unsymmetrical components, sequence networks, unsymmetrical fault analysis
4. Analyze steady state stability of power system
5. Analyze transient stability of power system

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	2	2	1							1		
CO 2	3	3	3	3	2							1		
CO 3	3	3	2	3								1		

CO 4	3	3	2	3							1		
CO 5	3	3	2	3							1		

SRI VENKATESA PERUMAL
COLLEGE OF ENGINEERING & TECHNOLOGY
| AUTONOMOUS | ACCREDITED BY NAAC |
RVS Nagar, K.N Road, Puttur, Chittoor dist, AP. I www.svpcet.org

NETWORK ANALYSIS AND SYNTHESIS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
20OE0212	OPEN ELECTIVE	3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes: 0	Practical Classes: 0				Total Classes: 48		

OBJECTIVES:

The course should enable the students to:

1. To learn the concepts of network analysis in electrical and electronics engineering.
2. To learn linear circuit analysis, graph theory and network theorems.
3. Analyze two port networks using Z, Y, ABCD and h parameters

UNIT - I	NETWORK TOPOLOGY	Classes: 10

Linear Oriented Graphs -incidence matrix of a linear oriented graph –Kirchoff's Laws in incidence matrix formulation –nodal analysis of networks (independent and dependent sources) – Circuit matrix of linear oriented graph –Kirchoff's laws in fundamental circuit matrix formulation.

UNIT - II	GRAPH THEORY	Classes: 10

Loop analysis of electric networks (with independent and dependent sources) - Planar graphs –Mesh analysis- Duality –Cut set matrix -Fundamental cut set matrix –Relation between circuit, cut set and incidence matrices –Kirchoff's laws in fundamental cut-set formulation –Node-pair analysis – Analysis using generalized branch model (node, loop and node pair analysis) –Tellegen's theorem.

UNIT - III	NETWORK FUNCTIONS	Classes: 10

Review of Network functions for one port and two port networks: – pole zero location for driving point and transfer functions-Impulse response of Network functions from pole-zero plots- Sinusoidal steady-state frequency response from pole-zero plots. Hurwitz polynomials –properties - Positive real functions –Properties of positive real functions – passivity-necessary and sufficient conditions for positive real functions-physical realizability.

UNIT - IV	TWO PORT NETWORKS	Classes: 9
Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, T & Π Representation.		

UNIT - V	NETWORK SYNTHESIS & FILTERS	Classes: 9

Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms. Image parameters and characteristics impedance, passive and active filter fundamentals, low pass, high pass, (constant K type) filters, and introduction to active filters.

Text Books:

1. K. S. Suresh Kumar, ―Electric Circuit Analysis‖, Pearson Publications, 2013.
2. Ravish R. Singh, "Network Analysis and Synthesis", McGraw-Hill Education, 2013
3.E. Van Valkenburg, “Network Analysis”, Prentice Hall of India
4.A C.L Wadhwa, “Network Analysis and Synthesis” New Age International Publishers, 2007,
5.Roy Choudhary, “Networks and Systems” Wiley Eastern Ltd.

Reference Books:

1.Franklin Kuo, ―Network Analysis and Synthesis‖, 2nd Ed.,Wiley India.
2. Van Valkenburg M.E., ―Introduction to Modern Network Synthesis,‖ Wiley Eastern, 1960 (reprint 1986).
3. Van Valkenburg M.E, ―Network Analysis,‖ Prentice Hall India, 2014.
4. E. Van Valkenburg, “An Introduction to Modern Network Synthesis”,Wiley Eastern Ltd.
5. Chakrabarti, “Circuit Theory” Dhanpat Rai & Co

Course Outcomes

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

1. Apply network topology concepts in the formulation and solution of electric network problems.
2. Apply two-port network analysis in the design and analysis of filter and attenuator networks.
3. Identify the properties and characteristics of network functions, and verify the mathematical constraints for their physical realization.
4. Synthesize an electric network using driving point functions
5. Design active and passive filter circuits

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	3								1		
CO 2	3	3	2	2								1		
CO 3	3	3	2	1								1		
CO 4	3	3	3	3								1		
CO 4	3	2	1	1								1		
AVG	3	2.6	1.8	2								1		