GOVERNMENT COLLEGE OF ENGINEERING, BARGUR

Regulation – 2018

AUTONOMOUS

Curriculum for Part Time – B.E. -EEE

From the Academic Year 2018-2019 onwards

PROGRAM OUTCOMES (POs)

PO1: An ability to apply knowledge of mathematics, science, and engineering,

PO2: An ability to design and conduct experiments, as well as to analyse and interpret data,

PO3: An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

PO4: An ability to function on multidisciplinary teams,

PO5: An ability to identify, formulate, and solve engineering problems,

PO6: An understanding of professional and ethical responsibility,

PO7: An ability to communicate effectively,

PO8 The broad education necessary to understand the impact of engineering solution in a global, economic, environmental, and societal context,

PO9: A recognition of the need for, and an ability to engage in life-long learning,

PO10: A knowledge of contemporary issues, and

PO11: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice,

PO12: With basic understanding of electrical and electronics principles students can become a member and then a team leader to manage innovative projects.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Apply the fundamentals of mathematics, science and engineering knowledge to identify, formulate, design and investigate complex engineering problems of electric circuits, analog and digital electronic circuits, electrical machines and power systems.

PSO2: Apply appropriate techniques and modern Engineering hardware and software tools in power systems to engage in life- long learning and to successfully adapt in multi-disciplinary environments.

PSO3: Ability to understand the recent technological developments in Electrical & Electronics Engineering and develop products to cater the societal & Industrial needs.

ELECTRICAL AND ELECTRONICS ENGINEERING (UG)

CURRICULUM DESIGN

CREDIT SUMMARY

Name of the UG Programme: **B.E - ELECTRICAL AND ELECTRONICS ENGINEERING (Part Time)**

Credit Summary

S. No	Sub. Area	Credits per Semester							Credits Total	% of Total Credits	Total no. of subjects
		I	II	III	IV	V	VI	VII			
1	BS	9	3						12	12.5	4
2	ES	1.5							1.5	1.5	1
3	PC	3	12	13.5	13.5	10.5	7.5	3	63	65.6	23
4	PE					3	6	6	15	15.6	5
5	PROJ							4.5	4.5	4.7	1
	Total	13.5	15	13.5	13.5	13.5	13.5	13.5	96	100	34

(An Autonomous Institution Affiliated to Anna University)

B.E ELECTRICAL AND ELECTRONICS ENGINEERING (Part Time)
2018 REGULATIONS

FIRST SEMESTER

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
THEORY								
1	18PTEBS101	Mathematics	BSC	45	3	0	0	3
2	18PTEBS102	Physics	BSC	45	3	0	0	3
3	18PTEBS103	Chemistry	BSC	45	3	0	0	3
4	18PTEPC104	Electric Circuit Analysis	PCC	45	2	1	0	3
PRACTICALS								
5	18PTEES105	Computer Programming Laboratory	ESC	45	0	0	3	1.5
				TOTAL	11	1	3	13.5

SECOND SEMESTER

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
THEORY								
1	18PTEPC201	DC Machines and Transformers	PCC	45	3	0	0	3
2	18PTEPC202	Electromagnetic Theory	PCC	45	2	1	0	3
3	18PTEBS203	Environmental Science and Engineering	BSC	45	3	0	0	3
4	18PTEPC204	Analog Electronics	PCC	45	2	1	0	3
5	18PTEPC205	Digital Logic Circuits	PCC	45	2	1	0	3
				TOTAL	12	3	0	15

THIRD SEMESTER

SI	Course Code	Course Name	Course	Contact	L	T	P	C

No			Category	Hours				
THEORY								
1	18PTEPC301	Synchronous and Asynchronous Machines	PCC	45	2	1	0	3
2	18PTEPC302	Control Systems	PCC	45	2	1	0	3
3	18PTEPC303	Linear Integrated Circuits and Applications	PCC	45	3	0	0	3
4	18PTEPC304	Transmission and Distribution	PCC	45	2	1	0	3
PRACTICALS								
5	18PTEPC305	Electrical Machines Laboratory	PCC	45	0	0	3	1.5
				TOTAL	9	3	3	13.5

FOURTH SEMESTER

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
THEORY								
1	18PTEPC401	Protection and Switchgear	PCC	45	3	0	0	3
2	18PTEPC402	Power Electronics	PCC	45	3	0	0	3
3	18PTEPC403	Measurements and Instrumentation	PCC	45	3	0	0	3
4	18PTEPC404	Power System Analysis	PCC	45	2	1	0	3
PRACTICALS								
5	18PTEPC405	Control and Instrumentation Laboratory	PCC	45	0	0	3	1.5
				TOTAL	11	1	3	13.5

FIFTH SEMESTER

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C

THEORY								
1	18PTEPC501	Microprocessors, Microcontrollers and Applications	PCC	45	3	0	0	3
2	18PTEPC502	Power System Operation and Control	PCC	45	3	0	0	3
3	18PTEPC503	Electrical Machine Design	PCC	45	2	1	0	3
4		Professional Elective I	PEC	45	3	0	0	3
PRACTICALS								
5	18PTEPC505	Power Electronics and Power System Laboratory	PCC	45	0	0	3	1.5
				TOTAL	12	0	3	13.5

SIXTH SEMESTER

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
THEORY								
1	18PTEPC601	Special Electrical machines	PCC	45	3	0	0	3
2	18PTEPC602	High Voltage Engineering	PCC	45	3	0	0	3
3		Professional Elective II	PEC	45	3	0	0	3
4		Professional Elective III	PEC	45	3	0	0	3
PRACTICALS								
5	18PTEPC605	Microprocessors, Microcontrollers and Applications Laboratory	PCC	45	0	0	3	1.5
				TOTAL	12	1	3	13.5

SEVENTH SEMESTER

Semester VII								
SI No	**Course Code**	**Course Name**	**Course Category**	**Contact Hours**	**L**	**T**	**P**	**C**

THEORY								
1	18PTEPC701	Energy utilization, conservation and auditing	PCC	45	3	0	0	3
2		Professional Elective IV	PEC	45	3	0	0	3
3		Professional Elective V	PEC	45	3	0	0	3
PRACTICALS								
4	18PTEPR704	Project Work	PROJ	135	0	0	9	4.5
				TOTAL	9	0	9	13.5

Grand Total Credits: 96

PROFESSIONAL ELECTIVES

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
1.	18PTEPE001	Applied Soft Computing	PEC	45	3	0	0	3
2.	18PTEPE002	Wind and Solar Energy Systems	PEC	45	3	0	0	3
3.	18PTEPE003	Biomedical Instrumentation	PEC	45	3	0	0	3
4.	18PTEPE004	Fundamentals of Nano Science	PEC	45	3	0	0	3
5.	18PTEPE005	Advanced Control System	PEC	45	2	1	0	3
6.	18PTEPE006	Power Quality and FACTS	PEC	45	3	0	0	3
7.	18PTEPE007	Microcontroller Based System Design	PEC	45	3	0	0	3
8.	18PTEPE008	High Voltage Direct Current Transmission	PEC	45	3	0	0	3
9.	18PTEPE009	Total Quality Management	PEC	45	3	0	0	3
10.	18PTEPE010	Power Electronics for Renewable Energy Systems	PEC	45	3	0	0	3
11.	18PTEPE011	Principles of Management	PEC	45	3	0	0	3
12.	18PTEPE012	Power System Dynamics and Control	PEC	45	2	1	0	3
13.	18PTEPE013	Electrical and Hybrid	PEC	45	3	0	0	3

		Vehicles						
14.	18PTEPE014	Computer Aided Design of Electrical Apparatus	PEC	45	3	0	0	3
15.	18PTEPE015	Power System Transients	PEC	45	2	1	0	3
16.	18PTEPE016	Solid State Drives	PEC	45	3	0	0	3
17.	18PTEPE017	Industrial Electrical Systems	PEC	45	3	0	0	3
18.	18PTEPE018	Fibre Optics and Laser Instruments	PEC	45	3	0	0	3
19.	18PTEPE019	Micro Electro Mechanical Systems	PEC	45	3	0	0	3

LIST OF ENGINEERING SCIENCE COURSES

S.No	Subject Code	Course Title	Course Category	Contact Hours	L	T	P	C
1.	18PTEES105	Computer Programming Laboratory	ESC	45	0	0	3	1.5

LIST OF BASIC SCIENCE COURSES

S.No	Subject Code	Course Title	Course Category	Contact Hours	L	T	P	C
1.	18PTEBS101	Mathematics	BSC	45	3	0	0	3
2.	18PTEBS102	Physics	BSC	45	3	0	0	3
3.	18PTEBS103	Chemistry	BSC	45	3	0	0	3
4.	18PTEBS203	Environmental Science and Engineering	BSC	45	3	0	0	3

LIST OF PROFESSIONAL CORE COURSES

S.No	Subject Code	Course Title	Course Category	Contact Hours	L	T	P	C
1.	18PTEPC104	Electric Circuit Analysis	PCC	45	2	1	0	3
2.	18PTEPC201	DC Machines and Transformers	PCC	45	3	0	0	3

3.	18PTEPC202	Electromagnetic Theory	PCC	45	2	1	0	3
4.	18PTEPC204	Analog Electronics	PCC	45	2	1	0	3
5.	18PTEPC205	Digital Logic Circuits	PCC	45	2	1	0	3
6.	18PTEPC201	DC Machines and Transformers	PCC	45	3	0	0	3
7.	18PTEPC202	Electromagnetic Theory	PCC	45	2	1	0	3
8.	18PTEPC204	Analog Electronics	PCC	45	2	1	0	3
9.	18PTEPC205	Digital Logic Circuits	PCC	45	2	1	0	3
10.	18PTEPC301	Synchronous and Asynchronous Machines	PCC	45	2	1	0	3
11.	18PTEPC302	Control Systems	PCC	45	2	1	0	3
12.	18PTEPC303	Linear Integrated Circuits and Applications	PCC	45	3	0	0	3
13.	18PTEPC304	Transmission and Distribution	PCC	45	2	1	0	3
14.	18PTEPC305	Electrical Machines Laboratory	PCC	45	0	0	3	1.5
15.	18PTEPC401	Protection and Switchgear	PCC	45	3	0	0	3
16.	18PTEPC402	Power Electronics	PCC	45	3	0	0	3
17.	18PTEPC403	Measurements and Instrumentation	PCC	45	3	0	0	3
18.	18PTEPC404	Power System Analysis	PCC	45	2	1	0	3
19.	18PTEPC405	Control and Instrumentation Laboratory	PCC	45	0	0	3	1.5
20.	18PTEPC501	Microprocessors, Microcontrollers and Applications	PCC	45	3	0	0	3
21.	18PTEPC502	Power System Operation and Control	PCC	45	3	0	0	3
22.	18PTEPC503	Electrical Machine Design	PCC	45	3	0	0	3
23.	18PTEPC505	Power Electronics and Power System Laboratory	PCC	45	0	0	3	1.5
24.	18PTEPC601	Special Electrical machines	PCC	45	3	0	0	3
25.	18PTEPC602	High Voltage Engineering	PCC	45	3	0	0	3

26.	18PTEPC605	Microprocessors, Microcontrollers and Applications Laboratory	PCC	45	0	0	3	1.5
27.	18PTEPC701	Energy utilization, conservation and auditing	PCC	45	3	0	0	3

SEMESTER-I

18PTEBS101	**MATHEMATICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:	
•	To know vector calculus and their uses in various field theoretic subjects
•	To know higher order and special type of linear differential equations and methods to find solutions

•	To understand the Laplace transforms and properties and their applications in engineering.
•	To know the Construction of analytic functions and concepts of concepts of conformal mapping, complex integration and series solutions

UNIT I	**MATRICES**	**9**

Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley-Hamilton Theorem – Diagonalization of matrices - Reduction of a quadratic form to canonical form by orthogonal transformation.

UNIT II	**FUNCTIONS OF SEVERAL VARIABLES**	**9**

Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of implicit functions –Taylor's series for functions of two variables - Maxima and minima of functions of two variables.

UNIT III	**ANALYTIC FUNCTION**	**9**

Analytic functions – Necessary and sufficient conditions for analyticity – Properties – Harmonic conjugates – Construction of analytic function – Conformal Mapping – Mapping by functions w = a + z, az, 1/z - Bilinear transformation.

UNIT IV	**COMPLEX INTEGRATION**	**9**

Line Integral – Cauchy's theorem and integral formula – Taylor's and Laurent's Series – Singularities– Residues – Residue theorem – Application of Residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT V	**LAPLACE TRANSFORM**	**9**

Existence conditions – Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals –Inverse transforms – Convolution theorem – Transform of periodic functions– Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL: 45 PERIODS

OUTCOMES:

•	use matrix algebra techniques for practical applications and understand the importance of functions of several variables and their applications in engineering.
•	understand the standard techniques of complex variable theory and apply them with confidence in areas such as heat conduction, elasticity, fluid dynamics and the flow of electric current

•	solve problems on Laplace transforms and use the transform techniques to find solutions to differential equations

TEXTBOOKS:	
1.	Grewal. B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2.	Ramana, B.V., "Higher Engineering Mathematics" Tata McGraw Hill Publishing Company, 2008

REFERENCES:	
1.	Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., 2011
2.	Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
3.	Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012
4.	Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, PEARSON Publishing, 2011
5.	Veerarajan, T.,"Engineering Mathematics(For first year)", Tata McGraw-Hill Pub. Pvt. Ltd., New Delhi, 2007.

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEBS102	PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:	
•	To develop knowledge on properties of solids
•	To understand the electrical properties of materials
•	To know about the properties of semiconductors
•	To become proficient in magnetic and dielectric materials
•	To apply principles of quantum physics in the engineering field

UNIT I	**PROPERTIES OF MATTER**	**9**
Elasticity – Hooke's law – Stress – Types of Stresses – Strain- Types of Strain - Young's Modulus – Rigidity Modulus – Bulk Modulus –Poisson's ratio – Relationship between three elastic constants and Poisson's ratio– Torsional Pendulum – Factors affecting elasticity of materials - Bending moment of a Beam – Depression of cantilever (Theory and Experiment) – Determination of Young's modulus – Uniform and non-uniform bending (Theory and Experiment).		
UNIT II	**ELECTRICAL PROPERTIES OF MATERIALS**	**9**
Conductors –Ohm's Law – Electrical conductivity – Relation between current density, drift velocity and mobility – Classical free electron theory of metals – Expression for electrical conductivity of a metal –Expression for thermal conductivity of a metal – Wiedemann – Franz law–Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states.		
UNIT III	**PROPERTIES OF SEMICONDUCTING MATERIALS**	**9**
Intrinsic semiconductor – Energy band diagram – Direct and indirect semiconductors – Carrier concentration in an intrinsic semiconductor (derivation) – Extrinsic semiconductors – n-type & p-type semiconductors – Determination of Bandgap of semiconductors (Experiment)		
UNIT IV	**MAGNETIC AND DIELECTRIC MATERIALS**	**9**
Magnetism in materials – magnetic field and induction – magnetization – magnetic permeability and susceptibility – types of magnetic materials –microscopic classification of magnetic materials –Domain theory of ferromagnetism. Dielectric materials: Polarization processes – dielectric loss – internal field – Clausius-Mosotti relation – dielectric breakdown – high-k dielectrics.		
UNIT V	**QUANTUM PHYSICS**	**9**
Blackbody radiation – Wien's displacement law – Rayleigh-Jean's law - Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh-Jean's law – Matter waves – De-Broglie's Hypothesis – Properties of matter waves - Wave-particle duality – Wavefunction and its physical Significance – Schrodinger wave equation – Time-dependent and time-independent – Application of Schrodinger wave equation: Particle in a 1 D box.		
		TOTAL: 45 PERIODS
OUTCOMES:		

•	To learn about three types of elastic modulus and able to calculate them for different materials
•	To learn about the electrical properties of materials and able to derive different parameters relevant to them
•	To learn about the properties of semiconductors and able to calculate quantities related to them.
•	To learn about types of magnetic materials and their types and functional knowledge of dielectric materials
•	To understand the quantum nature of materials and apply fundamental principles of quantum physics to the engineering field

TEXTBOOKS:

3.	P. Mani, "Engineering physics", Dhanam Publications, 2017.
4.	G. SenthilKumar, "Engineering physics", VRB Publishers
5.	A.Marikani, "Engineering Physics", PHI Learning Pvt., India 2009
6.	Wahen M. A. "Solid state physics: Structure and properties of materials" Narosa publishing house, 2009

REFERENCES:

6.	*R. K. Gaur and S.C. Gupta, "Engineering physics", DhanpatRai publications, New Delhi 2003.*
7.	*M. N. Avadhanulu and P. G. Kshirsagar, "A textbook of engineering physics", S. Chand and Company Ltd, New Delhi, 2005.*
8.	*K. Rajagopal, "Engineering Physics", PHI, New Delhi, 2011.*
9.	*P. K. Palanisamy, "Engineering Physics", SCITECH Publication, 2011*
10.	*M. Arumugam, "Engineering physics", Anuradha publishers*

COURSE ARTICULATION MATRIX

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

CO4	2								2	2			2	1	
CO5	2	2							2			2	2		

1-Low, 2-Moderate (Medium), 3-High

18PTEBS103	**CHEMISTRY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:	
•	To make students conversant with water parameters, boilers, need for water treatment and its merits and demerits.
•	Students ought to be aware of fundamental principles behind different electrochemical reactions, corrosion of materials and methods to prevent corrosion.
•	To learn the chemistry behind polymers, synthesis, merits, demerits and its applications in various field.
•	To acquire basic knowledge in renewable, non renewable and alternate energy resources and the chemical reactions involved in cell, batteries and its applications.
•	To learn the working principle of various spectroscopy and its applications.
•	To acquire basic knowledge in Nano materials, synthesis, properties and uses.

UNIT I	WATER TECHNOLOGY (CO-a &b)	9

Chararacteristics – alkalinity and its significance – hardness - types and estimation by EDTA method – specifications of drinking water (BIS and WHO standards) – potable water treatment – boiler feed water - requirements – disadvantages of using hard water in boilers – water treatment – Internal treatment – external treatment – zeolite method - Demineraliztion process – desalination – reverse osmosis.

UNIT II	ELECTROCHEMISTRY AND CORROSION (CO-a &c)	9

Electrochemistry: Electrochemical cells – reversible and irreversible cells – EMF – measurement of EMF – single electrode potential – Nernst equation (Problems) – reference electrode – standard hydrogen electrode and calomel electrode – ion selective electrode – glass electrode and measurement of pH – electrochemical series and its applications.

Corrosion: Corrosion – Pilling Bedworth rule - dry corrosion - electrochemical corrosion and its mechanism – types (galvanic, pitting, differential aeration) – factors influencing corrosion – corrosion control methods - sacrificial anode method – impressed current method – corrosion inhibitors – protective coatings – paints – constituents – functions

UNIT III	POLYMERS AND COMPOSITES (CO-a &d)	9

Polymers: Definition – classification – functionality – polymerization – degree of polymerization – types (addition, condensation, copolymerization) – mechanism (free radical) – plastics – thermoplastics and thermosetting plastics – preparation, properties and uses of individual polymers (PVC, TEFLON, Nylon-6,6, Nylon-6, PET, epoxy resin) – rubber - vulcanization of rubber – applications

Composites: definition – types polymer matrix composites – Fibre Reinforced Polymers – applications – advanced composite materials – physical and chemical properties – applications.

UNIT IV	ENERGY SOURCES AND STORAGE DEVICES (CO-a &e)	9

Renewable and non renewable energy resources -Nuclear energy – fission fusion reactions – light water nuclear reactor for power generation – breeder reactor – solar energy conversion – solar cells – wind energy – batteries: alkaline batteries – lead –acid, Ni-Cd ,and Li-ion batteries – fuel cells – principles and applications – advantages and disadvantages.

UNIT V	NANOCHEMISTRY (CO-a &f)	9

Nanomaterials: Introduction to nanotechnology in electronics - nanomaterials – fullerernes carbon nanotubes – nanowires – special properties - synthesis of nanomaterials – topdown and bottomup approach – applications of nanomaterials in electrical and electronic appliances (Semiconductors, LED & OLED) – electrical appliances – medicines.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course students should be able to

a.	Ability to apply the knowledge of basic science in identifying, to formulate and to solve the engineering problems.
b.	Ability to analyze water borne problems faced in boilers, need for water treatment and various methods and techniques for treating hard water.
c.	Develop ability to advance polymer materials and its applications in engineering field.
d.	Ability to understand the mechanism behind various types of electrochemical reactions which in turn helps in understanding the causes for corrosion and prevention methods.
e.	Acquires Knowledge about energy conversion and chemical reaction taking place in nuclear, solar, wind energy, Batteries, fuel cells and its applications, merits and demerits.
f.	Acquires in-depth knowledge on various nanomaterials and its applications in electrical devices. Students get basic knowledge on advanced analytical techniques.

TEXT BOOKS:

1. *Vairam S, Kalyani P and SubaRamesh.,"Engineering Chemistry"., Wiley India PvtLtd.,New Delhi., 2011*
2. *Dara S.S,UmareS.S."Engineering Chemistry", S. Chand & Company Ltd., New Delhi , 2010*

REFERENCES:

1. *Pahari A and Chauhan B., "Engineering Chemistry"., Firewall Media., New Delhi., 2010.*
2. *Rao, C. N. R.; Govindaraj, A. "Nanotubes and Nanowires" United Kingdom: Royal Society of Chemistry, 2005*
3. *Advanced Polymeric Materials: From Macro- to Nano-Length Scales edited by Sabu Thomas, Nandakumar Kalarikkal, Maciej Jaroszewski, Josmine P. Jose; Apple Academic press, Canada, 2016*

4.	*Jain and jain , 16th editin, "Engineering Chemistry" Dhanpat Rqai Publishing Co.*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				2			3	2				1	2	
CO2	3				2			2	2				2	1	
CO3	2				2			3	2				1	2	
CO4	2				2			3	2				1	1	
CO5	2				2			2	2				2	2	
CO6	2				2			3	2				1	2	
CO7	2				2			3	2				1	2	

1-Low, 2-Moderate (Medium), 3-High

18PTEPC104	**ELECTRIC CIRCUIT ANALYSIS**	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**

OBJECTIVES:	
•	To introduce electric circuits and its analysis
•	To impart knowledge on solving circuits using network theorems
•	To introduce the phenomenon of resonance in coupled circuits
•	To educate on obtaining the transient response of circuits
•	To Phasor diagrams and analysis of three phase circuits

UNIT I	**BASIC CIRCUITS ANALYSIS**	**9**

Ohm'sLaw–Kirchhoff's laws–DC and AC Circuits–Resistors in series and parallel circuits– Mesh current and Node voltage analysis for D.C and A.C.circuits–Phasor Diagram – Power, PowerFactor and Energy.

UNIT II	**NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS**	**9**

Network reduction: voltage and current division, source transformation– stardelta conversion. Thevenin and Norton Theorem– Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.		
UNIT III	**RESONANCE AND COUPLED CIRCUITS**	**9**
Series and parallel resonance–their frequency response– Quality factor and Bandwidth–Coupled Circuits- Selfand mutual inductance–Coefficient of coupling– Analysis of coupled circuits-Tuned circuits–Single and double tuned circuits.		
UNIT IV	**CIRCUIT TRANSIENTS**	**9**
Laplace Transformations-Advantages-Laplace transformation of some functions-RL transient-Decay of current in RL Circuits-RC Transient: Decay of Current in RC Circuits-RLC Transient: Over-damped, Critically Damped and Underdamped-AC Transients-RL, RC and RLC Circuits-Natural Frequency and Damping Ratio.		
UNIT V	**THREE PHASE CIRCUITS**	**9**
Comparison between single phase and poly phase systems-Three phase balanced/ unbalanced sources– analysis of three phase 3-wire and 4-wire circuits with star and delta connection-balanced and unbalanced loads-– phasor diagram of voltages and currents–power and powerfactor measurements in three phase circuits.		
		TOTAL :45 PERIODS

OUTCOMES:	After successful completion of the course students able to
•	Explain circuit behaviour using ohm's law and Kirchhoff laws, hence solve the circuits using mesh and nodal analysis
•	State various circuit laws and theorems and perform the circuit analysis to prove the theorems.
•	Explain the behaviour of resonance and magnetically coupled circuits.
•	Explain AC circuits using phasor techniques under steady stateand transient conditions for any first order and second ordersystems using R, L, and C Circuits.
•	Analyze AC circuits using phasor techniques

TEXT BOOKS:

1.	Arumugam M and Prem Kumar, "Electric Circuit Theory", Khanna Publishers, New Delhi,2006

2.	Sudhakar A and Shyam Mohan SP,"Circuits and Network Analysis and Synthesis",TataMcGraw Hill,2015.
REFERENCES:	
1.	*Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum'sseries, TataMcGraw-Hill,New Delhi,2014.*
2.	*Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., New Delhi, 1996.*
3.	*Ashfaq Husain and Harroon Ashfaq, "Fundamentals of Electrical Engineering", Dhanpath Rai & Sons, New Delhi, 2016*
4.	*William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", Tata McGraw Hill publishers, 6 edition, New Delhi, 2003.*
5.	*CharlesK.Alexander,Mathew N.O.Sadiku,"Fundamentals of Electric Circuits",Second Edition, McGrawHill, 2013.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

17PTEES105	COMPUTER PROGRAMMING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- Be familiar with the use of Unix OS.
- Be exposed to presentation and visualization tools.
- Be exposed to problem solving techniques and flow charts.
- Be familiar with programming in C.
- Learn to use Arrays, strings, functions, structures and unions.

LISTOFEXPERIMENTS:

UNIX Commands

1. Study of UNIX OS.
2. Basic UNIX commands.
3. Directory commands and Process Management commands.
4. Study of vi Editor

Shell Programming

Simple Shell Programming

5. a) Program for getting and displaying the academic and personal details.
   b) Program to demonstrate the Arithmetic Operations.

Conditional statements

6. a) Program to find whether a number is odd or even
   b) Program to find whether a number is Positive (or) Negative

c) Program to find the biggest number among three numbers

d) Program to perform Arithmetic Operations using Switch Case

e) Program to find the area of Circle, Square , Rectangle ,Triangle.

Testing and loops

7. a) Program to print the Fibonacci serious

b) Program to find whether a number is a Armstrong number

c) Program to find the Sum of even numbers up to N

d) Program to print the various Combinations of 123

e) Program to find the n^{th} power of given number

C Programming

8. a) Program to check whether a sting is a Palindrome

b) Program to perform the Concatenation of two strings

9. Program to find the biggest number among n numbers using functions.

10. Program to swap of two numbers using pointers.

11. Program to read contents of a File and to Print the same.

12. Program to demonstrate Dynamic memory allocation.

TOTAL : 45 PERIODS

OUTCOMES:

1.	An ability to do simple shell and C programming.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1				2		3			1		2			2	

1-Low, 2-Moderate (Medium), 3-High

II SEMESTER

18PTEPC201	DC MACHINES AND TRANSFORMERS	L	T	P	C
		3	0	0	3

OBJECTIVE:	
•	To introduce the concept of magnetic circuits and electromechanical energy theory.
•	To study the construction, operation and characteristics of Dc Generators and Motors
•	To study the construction, operation and characteristics of Transformers
•	To determine the losses and efficiency in dc machines and transformers by conducting various tests.
•	To test the DC Machines and Transformers

UNIT I	BASIC CONCEPTS OF ROTATING MACHINES	9

Magnetic Circuits - Principles of electromechanical energy conversion – Single and multiple excited systems – concept of co-energy– Generated voltage – Torque in DC machine.

UNIT II	DC GENERATORS	9

Constructional details – emf equation – Methods of excitation – Self and separately excited generators – Characteristics of series, shunt and compound generators – Armature reaction and commutation – Parallel operation of DC shunt and compound generators.

UNIT III	DC MOTORS	9

Principle of operation – Back emf and torque equation – Characteristics of series, shunt and compound motors – Starting of DC motors – Types of starters – Speed control of DC series and shunt motors.

UNIT IV	TRANSFORMERS	9

Constructional details of core and shell type transformers – Types of windings – Principle of operation – emf equation – Transformation ratio – Transformer on no-load – Parameters referred to HV / LV windings – Equivalent circuit – Transformer on load – Regulation – Parallel operation of single phase transformers – Auto transformer – Three phase transformers – Vector group.

UNIT V	TESTING OF DC MACHINES AND TRANSFORMERS	9

Losses and efficiency in DC machines and transformers – Condition for maximum efficiency – Testing of DC machines – Brake test, Swinburne's test, Retardation test and Hopkinson's test – Testing of transformers – Polarity test, load test, open circuit and short circuit tests – All day efficiency.

TOTAL : 45 PERIODS

OUTCOMES:	After successful completion of the course, the students able to
1.	Explain the concept of magnetic circuits and electromechanical energy theory.
2.	Explain the construction, operation and characteristics of Dc Generators and Motors
3.	Explain the construction, operation and characteristics of Transformers
4.	Determine the losses and efficiency in dc machines and transformers by conducting various tests.
5.	Test the DC Machines and Transformers

TEXT BOOKS:	
1.	Fitzgerald A.E. Kingsly C., Umans S.D., '*Electrical Machinery'* 6th edition, McGraw Hill International Edition, New York, 2002.
2.	Kothari D.P. and Nagrath I.J , "*Electric Machines*", Tata McGraw Hill, Fourth Ed., 2011.
3.	P. C. Krause, O. Wasynczuk and S. D. Sudhoff, "Analysis of electric machinery," IEEE Press, 1995.
REFERENCES:	
1.	*D.P.Kothari, "Electrical Machines" 3rd edition, TMH, New Delhi 2004.*
2.	*P.C.Sen, "Principles of Electrical Machines and Power Electronics", John-Wiley & Sons, Newyork.*
3.	*Cotton H, "Advanced Electrical Technology", CBS Publishers and Distributors, 1967.*
4.	*P.S.Bimbhra, 'Electrical Machinery',Khanna Publishers,2003.*
5.	*Fitzgerald A.E., Kingsly C. and Kusko.A., "Electric Machinery", Tata McGraw Hill, 2007.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPC202	ELECTROMAGNETIC THEORY	L	T	P	C
		2	1	0	3

OBJECTIVES:		
•	To study the coordinate systems, vector calculus and theorems to electric and magnetic fields.	
•	To compare the nature, characteristics, properties and applications of Electric and Magnetic fields with the help of fundamental laws of fields.	
•	To introduce voltage, and current using electric fields and Develop resistance, capacitance and inductance of a given electrical component.	
•	To Relate electric and magnetic fields with help of Faraday‘s Law and Maxwell‘s Equation, and, their applications to electrical machines.	
•	To study Electromagnetic Wave propagation, Poynting Vector and Poynting Theorem and Appreciate the significance of electric and magnetic fields in electrical engineering	
UNIT I	**INTRODUCTION**	**9**
Sources and effects of electromagnetic fields – Vector fields – Different co-ordinate systems-vector calculus – Gradient, Divergence and Curl - Divergence theorem – Stoke’s theorem.		
UNIT II	**ELECTROSTATICS**	**9**
Coulomb’s Law – Electric field intensity – Field due to point and continuous charges – Gauss’s law and application – Electric potential – Electric field and equipotential plots – Electric field in free space, conductors, dielectric - Dielectric polarization – Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson’s and Laplace’s equations – Capacitance-Energy density.		
UNIT III	**MAGNETOSTATICS**	**9**
Lorentz Law of force, magnetic field intensity – Biot–Savart Law - Ampere’s Law – Magnetic field due to straight conductors, circular loop, infinite sheet of current – Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization – Magnetic field in multiple media –Boundary conditions – Scalar and vector potential – Magnetic force – Torque – Inductance – Energy density – Magnetic circuits.		
UNIT IV	**ELECTRODYNAMIC FIELDS**	**9**
Faraday’s laws – induced emf – Transformer and motional EMF – Forces and Energy in quasi stationary Electromagnetic Fields - Maxwell’s equations (differential and integral forms) – Displacement current – Relation between field theory and circuit theory.		
UNIT V	**ELECTROMAGNETIC WAVES**	**9**
Electromagnetic wave equations – Wave parameters; velocity, intrinsic impedance, propagation constant– Waves in free space ,lossy and lossless dielectrics , conductors – skin depth, Poynting vector – Transmission lines – Line equations– Input impedances – Standing wave ratio and power.		
		TOTAL : 45 PERIODS

OUTCOMES:	After completion of this course, the student will be able to:
1.	Describe the coordinate systems, vector calculus and theorems to electric and magnetic fields.
2.	Compare the nature, characteristics, properties and applications of Electric and Magnetic fields with the help of fundamental laws of fields.
3.	Explain voltage, and current using electric fields and Develop resistance, capacitance and inductance of a given electrical component.
4.	Relate electric and magnetic fields with help of Faraday‘s Law and Maxwell‘s Equation, and, their applications to electrical machines.

5.	Explain Electromagnetic Wave propagation, Poynting Vector and Poynting Theorem and Appreciate the significance of electric and magnetic fields in electrical engineering
TEXT BOOKS:	
1.	Mathew N. O. Sadiku, "Elements of Electromagnetics", Oxford University press Inc. India Edition, 2014.
2.	Joseph. A. Edminister, "Theory and Problems of Electromagnetics", 2nd Edition, Schaum Series, Tata McGraw Hill, 1993.
3.	K.A.Gangadhar,P.M.Ramanthan'ElectromagneticFieldTheory(includingAntennaesand wave propagation)', 16th Edition,KhannaPublications,2008.
REFERNCE:	
1.	*Ashutosh Pramanik, "Electromagnetism – Theory and Applications", Prentice-Hall of India Private Limited, New Delhi, 2008.*
2.	*William. H. Hayt, "Engineering Electromagnetics", Tata McGraw Hill, 2011*
3.	*Kraus and Fleish, "Electromagnetics with Applications", McGraw Hill International Editions, 5th Edition, 1999.*
4.	*Bhag Singh Guruand Hüseyin R. Hiziroglu "Electromagnetic field theory Fundamentals", CambridgeUniversityPress;SecondRevisedEdition,2009.*
5.	*S.P.Seth, "Elements of Electromagnetic Fields", Dhanpath Rai & Sons, New Delhi, 2001.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEBS203	**ENVIRONMENTAL SCIENCE AND ENGG.**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
OBJECTIVES:					
•	To finding and implementing scientific, technological, economic and political				

	solutions to environmental problems.
•	To study the interrelationship between living organism and environment.
•	To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
•	To study the dynamic processes and understand the features of the earth's interior and surface.
•	To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY (CO-a &b)**	**12**

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical 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-spots 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. Field study of common plants, insects, birds.

Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II	**ENVIRONMENTAL POLLUTION & HEALTH RISK (CO-a &c)**	**9**

Definition – causes, effects and control measures of: (a) Air Pollution: Causes, effects and prevention (b) Water pollution: Causes, effects and prevention (d) Marine pollution (f) Thermal pollution pollution - soil waste management: causes, effects and control measures of municipal solid wastes – case studies

Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III	**NATURAL RESOURCES (CO-a &d)**	**11**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources:

Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. **Field study of local area to document environmental assets – river / forest / grassland / hill**

UNIT IV	**SOCIAL ISSUES AND THE ENVIRONMENT (CO-a &e)**	**7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labelling of environmentally friendly products (Ecomark). - Central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

UNIT V	**HUMAN POPULATION AND THE ENVIRONMENT (CO-a &f)**	**6**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA) -GIS-remote sensing-role of information technology in environment and human health – Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

a.	Ability to apply the knowledge of environmental science in identifying, to formulate and to solve the environmental problems.
b.	Public awareness of environmental function is at infant stage.
c.	Ignorance and incomplete knowledge has led to misconceptions.
d.	Development and improvement in std. of living has led to serious environmental disasters.
e.	Acquires Knowledge about environmental laws.
f.	Acquires in-depth knowledge on population explosion and role of IT in environmental management.

TEXT BOOKS:	
1.	Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
2.	Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
REFERENCES:	
1	*R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.*
2	*Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.*
3	*Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi,2007.*
4	*Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press 2005.*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		1		2			3	2				1	2	
CO2	3		2		2			2	2				2	1	
CO3	2		1		2			3	2				1	2	
CO4	2		1		2			3	2				1	1	
CO5	2		2		2			2	2				2	2	
CO6	2		2		2			3	2				1	2	
CO7	2		1		2			3	2				1	2	

1-Low, 2-Moderate (Medium), 3-High

18PTEPC204	ANALOG ELECTRONICS	L	T	P	C
		2	1	0	3
OBJECTIVES:					
•	To introduce the concept of PN Diode and its applications.				
•	To study the the characteristics and applications BJTs, and MOSFETs.				
•	To study the various biasing methods and circuits for the BJT and MOSFET amplifiers				
•	To introduce the characteristics and applications of feedback amplifiers and oscillators				

•	To introduce the characteristics and applications of pulse circuits	
UNIT I	**PN DIODE AND ITS APPLICATIONS**	**9**
PN junction diode -VI characteristics – Resistance - temperature effects – Drift and diffusion currents – Rectifiers: HW, FW, Bridge Rectifiers, filters - Zener diode – Characteristics - LED – Regulators (series and shunt) - Introduction to Switched mode power supply(Quantitative treatment only).		
UNIT II	**BJT AND FETS**	**9**
Bipolar junction transistor – Construction – Input and output characteristics – CE, CB and CC configurations – hybrid model – Analytical expressions - JFET – VI characteristics, Pinch off Voltage– small signal model - MOSFET - Characteristics – enhancement and depletion mode.		
UNIT III	**BIASING AND AMPLIFIERS**	**9**
Need for biasing - Different types of biasing circuits –BJT-FET-Small signal analysis-Classification of amplifiers -CE CB amplifier - frequency response - Class A, B, AB, C and D -RC and transformer coupled power amplifiers - Class B complementary- symmetry, push-pull power Amplifiers-Darlington connection.		
UNIT IV	**FEEDBACK AMPLIFIERS AND OSCILLATORS**	**9**
Differential amplifiers: Common Mode and Differential Mode - CMRR – feedback amplifiers - Voltage / current, series / shunt feedback –condition for oscillation - oscillators – LC, RC, crystal oscillators.		
UNIT V	**PULSE CIRCUITS**	**9**
RC wave shaping circuits – Diode clampers and clippers – Monostable, Astable and Bistable Multivibrators – Schmitt triggers – UJT based saw tooth oscillators.		
	TOTAL : 45 PERIODS	

OUTCOMES:	After completion of this course, the student will be able to:
1.	Explain the characteristics and applications of PN Diode and its applications
2.	Explain the characteristics and applications BJTs, and MOSFETs.
3.	Compare various biasing methods and circuits for the BJT and MOSFET amplifiers
4.	Explain the characteristics and applications of feedback amplifiers and oscillators.
5.	Explain the characteristics and applications of pulse circuits

TEXT BOOKS:

1.	Paynter, "Introductory electronic devices and circuits", PHI, 2006.
2.	David Bell, "Electronic Devices and Circuits", PHI, 2007.

REFERNCE:

1.	*Theodre F. Boghert, "Electronic Devices & Circuits" Pearson Education, 6th Edition, 2003.*
2.	*Rashid, "Microelectronic circuits", Thomson Publication, 1999.*
3.	*Singh. B.P and Rekha Singh, "Electronic Devices and Integrated Circuits", Pearson Education, 2006.*
4.	*Salivahanan. S, Suresh Kumar. N and Vallavaraj. A, "Electronic Devices and circuits", Tata McGraw Hill, 2003.*
5.	*RobertL.Boylestad,"ElectronicDevicesandCircuittheory",2002.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPC205	**DIGITAL LOGIC CIRCUITS**	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**

OBJECTIVES:

- To study various number systems and simplify the logical expressions using Boolean functions
- To study combinational circuits
- To design various synchronous and asynchronous circuits
- To introduce asynchronous sequential circuits and PLDs
- To introduce digital simulation for development of application oriented logic circuits

UNIT I	**NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES**	**9**

Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code) – Digital Logic Families – Comparison of RTL, DTL, TTL, ECL and MOS families – Operation, characteristics of digital logic family.		
UNIT II	**COMBINATIONAL CIRCUITS**	**9**
Combinational logic – Representation of logic functions – SOP and POS forms – K-map representations – Minimization using K maps – Simplification and implementation of combinational logic – Multiplexers and de multiplexers – Code converters, adders, subtractors, Encoders and Decoders.		
UNIT III	**SYNCHRONOUS SEQUENTIAL CIRCUITS**	**9**
Sequential logic – SR, JK, D and T flip flops – Level triggering and edge triggering – Counters – Asynchronous and synchronous type – Modulo counters – Shift registers – Design of synchronous sequential circuits – Moore and Melay models – Counters – State diagram – State reduction – State assignment.		
UNIT IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES**	**9**
Asynchronous sequential logic circuits – Transition stability, flow stability – Race conditions, hazards &errors in digital circuits – Analysis of asynchronous sequential logic circuits – Introduction to Programmability Logic Devices: PROM – PLA –PAL – CPLD – FPGA		
UNIT V	**VHDL**	**9**
RTL Design – Combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation / Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).		
TOTAL :45 PERIODS		

OUTCOMES: After completion of this course, the student will be able to:	
1	Design combinational and sequential Circuits
2	Illustrate various number systems and simplify the logical expressions using Boolean functions
3	Design various synchronous and asynchronous circuits.
4	Design asynchronous sequential circuits and PLDs
5	Simulate digital simulation for development of application oriented logic circuits.
TEXTBOOKS :	
1	James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
2	M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.
3	Comer "Digital Logic & State Machine Design, Oxford, 2012.
REFERENCES :	
1	*Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.*
2	*William Keitz, "Digital Electronics-A Practical Approach with VHDL", Pearson, 2013.*
3	*Thomas L.Floyd, "Digital Fundamentals", 11th edition, Pearson Education, 2015.*
4	*Charles H.Roth, Jr, Lizy Lizy Kurian John, "Digital System Design using VHDL", Cengage, 2013.*
5	*D.P.Kothari, J.S.Dhillon, "Digital circuits and Design", Pearson Education, 2016.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

III SEMESTER

18PTEPC301	SYNCHRONOUS AND ASYNCHRONOUS MACHINES	L	T	P	C
		2	1	0	3

OBJECTIVES:

•	To study Construction and performance of salient and non – salient type synchronous generators.
•	To understand Principle of operation and performance of synchronous motor.
•	To study Construction, principle of operation and performance of induction machines.
•	To understand Starting and speed control of three-phase induction motors.
•	To understand Construction, principle of operation and performance of single phase

	induction motors and special machines.	
UNIT I	**THREE PHASE INDUCTION MOTOR**	**09**
Constructional details – Types of rotors –- Principle of operation – Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Double cage induction motors –Induction generators – Synchronous induction motor.		
UNIT II	**STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR**	**09**
Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star-delta starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded connection-V/f control – Slip power recovery scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.		
UNIT III	**SYNCHRONOUS GENERATOR**	**09**
Constructional details – Types of rotors –winding factors- emf equation – Synchronous reactance – Armature reaction – Phasor diagrams of non salient pole synchronous generator connected to infinite bus--Synchronizing and parallel operation – Synchronizing torque -Change of excitation and mechanical input- Voltage regulation – EMF, MMF, ZPF and A.S.A methods – steady state power- angle characteristics– Two reaction theory –slip test -short circuit transients - Capability Curves.		
UNIT IV	**SYNCHRONOUS MOTOR**	**09**
Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed-Hunting – natural frequency of oscillations – damper windings- synchronous condenser.		
UNIT V	**SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES**	**09**
Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor- Servo motors- Stepper motors - introduction to magnetic levitation systems.		
		TOTAL :45 PERIODS
OUTCOMES: After completion of this course, the student will be able to:		
1	Explain the construction and working principle of Synchronous Generator	
2	Explain the construction and working principle of Synchronous motor	
3	Explain the construction and working principle of Three phase Induction Motor	
4	Determine the performance characteristics of Synchronous Machines	
5	Explain the construction and working principle of Special Machines	
TEXTBOOKS :		
1	A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, “Electric Machinery”, Mc Graw Hill publishing Company Ltd, 2003.	
2	Vincent Del Toro, “Basic Electric Machines”, Pearson India Education, 2016.	
3	Stephen J. Chapman, “Electric Machinery Fundamentals”, 4th edition, McGraw Hill Education Pvt. Ltd, 2010.	

REFERENCES :	
1	*D.P. Kothari and I.J. Nagrath, "Electric Machines", McGraw Hill Publishing Company Ltd, 2002.*
2	*P.S. Bhimbhra, "Electrical Machinery", Khanna Publishers, 2003.*
3	*M.N. Bandyopadhyay, "Electrical Machines Theory and Practice", PHI Learning PVT LTD.,New Delhi, 2009.*
4	*B.R.Gupta, "Fundamental of Electric Machines" New age International Publishers,3rd Edition ,Reprint 2015.*
5	*Murugesh Kumar, "Electric Machines", Vikas Publishing House Pvt. Ltd, 2002.*
6	*Alexander S. Langsdorf, "Theory of Alternating-Current Machinery", McGraw Hill Publications, 2001.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPC302	CONTROL SYSTEMS	L	T	P	C
		2	1	0	3
OBJECTIVES:					
•	To understand the use of transfer function models for analysis physical systems and introduce the control system components.				
•	To provide adequate knowledge in the time response of systems and steady state error analysis.				
•	To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.				
•	To introduce stability analysis and design of compensators				
•	To introduce state variable representation of physical systems and study the effect of state feedback				
UNIT I	**SYSTEMS AND THEIR REPRESENTATION**		**9**		
Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.					
UNIT II	**TIME RESPONSE**		**9**		

Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effects of P, PI, PID modes of feedback control –Time response analysis		
UNIT III	**FREQUENCY RESPONSE**	**9**
Frequency response – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications- Effect of Lag, lead and lag-lead compensation on frequency response- Analysis		
UNIT IV	**STABILITY AND COMPENSATOR DESIGN**	**9**
Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria – Lag, lead and lag-lead networks – Lag/Lead compensator design using bode plots		
UNIT V	**STATE VARIABLE ANALYSIS**	**9**
Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability – Effect of state feedback		
		TOTAL : 45 PERIODS

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

1.	Apply basic science, circuit theory, theory control theory Apply Signal processing to electrical engineering problems
2.	Demonstrate time response and Effects of P, PI, PID controllers.
3.	Demonstrate frequency response, stability and compensator design.
4.	Analyse the state variable of the linear and time invariant Systems.
5.	Analyse the concept of state variables, controllability and observerbility

TEXT BOOKS:

1.	I.J.Nagrath and M. Gopal, 'Control Systems Engineering', 6th Edition, New Age International Publishers, 2018
2.	Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Pearson Prentice Hall, 2012.

REFERENCES:

1.	*Arthur, G.O.Mutambara, Design and Analysis of Control; Systems, CRC Press, 2009*
2.	*S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.*
3.	*Benjamin C. Kuo, Automatic Control systems, 7th Edition, PHI, 2010.*
4.	*Dhanesh. N. Manik, Control System, Cengage Learning, 2012.*
5.	*K. Ogata, 'Modern Control Engineering', 5th edition, PHI, 2012*

COURSE ARTICULATION MATRIX

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

CO4	2	3			1			3				2	3		1
CO5		3	2					2			1	2	2	1	

1-Low, 2-Moderate (Medium), 3-High

18PTEPC303	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge in IC fabrication procedure.
- To analyse the characteristics of Op-Amp.
- To understand the importance of Signal analysis using Op-amp based circuits.
- To study about Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
- To understand and acquire knowledge on the Applications of Op-amp

UNIT I	IC FABRICATION	09

IC classification – Fundamental of monolithic IC technology – Epitaxial growth – Masking and etching – Diffusion of impurities – Realisation of monolithic ICs and packaging – Fabrication of diodes, capacitance, resistance, FETs and PV Cell.

UNIT II	CHARACTERISTICS OF OPAMP	09

Ideal OP-AMP characteristics – DC characteristics – AC characteristics – Differential amplifier – Frequency response of OP-AMP – Basic applications of op-amp – Inverting and Non-inverting Amplifiers – Summer, differentiator and integrator – V/I, I/V and F/V converters.		
UNIT III	**APPLICATIONS OF OPAMP**	**09**
Instrumentation amplifier and its applications for transducer Bridge – Log and Antilog Amplifiers – Analog multiplier & Divider – First and second order active filters – Comparators – Multivibrators – waveform generators – Clippers – Clampers – Peak detector – S/H circuit – D/A converter (R- 2R ladder and weighted resistor types) – A/D converters using op-amps.		
UNIT IV	**SPECIAL ICs**	**09**
Functional block and characteristics of 555 Timer – PWM application – IC 566 voltage controlled oscillator – IC 565-phase locked loop IC – AD633 Analog multiplier ICs		
UNIT V	**APPLICATION ICs**	**09**
AD623 Instrumentation Amplifier and its application as load cell weight measurement – IC voltage regulators – LM78XX, LM79XX Fixed voltage regulators its application as Linear power supply – LM317, 723 Variability voltage regulators – Switching regulator – SMPS – ICL 8038 function generator IC.		
TOTAL :45 PERIODS		

OUTCOMES: After completion of this course, the student will be able to:	
1	Explain IC fabrication procedure.
2	Analyse the characteristics of Op-Amp.
3	Analysis of Signal using Op-amp based circuits.
4	Design of Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
5	Apply the ICs in various Electronic Circuits
TEXTBOOKS :	
1	David A. Bell, "Op-amp & Linear ICs", Oxford, 2013
2	D. Roy Choudhary, Sheil B. Jani, "Linear Integrated Circuits", II edition, New Age, 2003.
3	Ramakant A.Gayakward, "Op-amps and Linear Integrated Circuits", IV edition, Pearson Education, 2003 / PHI. 2000.
REFERENCES :	
1	*Fiore, " Opamps & Linear Integrated Circuits Concepts & applications", Cengage, 2010.*
2	*Floyd ,Buchla, "Fundamentals of Analog Circuits, Pearson, 2013.*
3	*Jacob Millman, Christos C.Halkias, "Integrated Electronics - Analog and Digital circuits system", McGraw Hill, 2003.*
4	*Robert F.Coughlin, Fredrick F. Driscoll, "Op-amp and Linear ICs", Pearson, 6th edition,2012.*
5	*Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Mc Graw Hill, 2016.*
6	*Muhammad H. Rashid, "Microelectronic Circuits – Analysis and Design" Cengage Learning, 2011.*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	2	2							2				2		
CO2			2			2				1					2
CO3	2												2		
CO4		2					2		3				3		
CO5			2				2								2

1-Low, 2-Moderate (Medium), 3-High

18PTEPC304	**TRANSMISSION AND DISTRIBUTION**	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**

OBJECTIVES:

- To study the structure of electric power system and to develop expressions for the computation of transmission line parameters.
- To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.
- To understand the mechanical design of transmission lines and to analyze the voltage distribution in insulator strings to improve the efficiency.
- To study the types, construction of cables and methods to improve the efficiency.
- To study about distribution systems, types of substations, methods of grounding, EHVAC, HVDC and FACTS.

UNIT I	**TRANSMISSION LINE PARAMETERS**	**09**

Structure of Power System – Parameters of single and three phase transmission lines with single and double circuits – Resistance, inductance and capacitance of solid, stranded and bundled conductors – Symmetrical and unsymmetrical spacing and transposition – Application of self and mutual GMD – Skin and proximity effects – Typical configurations – Conductor types and

electrical parameters of EHV lines.		
UNIT II	**MODELLING AND PERFORMANCE OF TRANSMISSION LINES**	**09**
Performance of Transmission lines – Short line, medium line and long line – Equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance – Transmission efficiency and voltage regulation – Real and reactive power flow in lines – Power Circle diagrams – Formation of Corona – Critical Voltages – Effect on Line Performance.		
UNIT III	**MECHANICAL DESIGN OF LINES**	**09**
Mechanical design of OH lines – Line Supports – Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading. – Insulators: Types – Voltage distribution in insulator string – Improvement of string efficiency – Testing of insulators.		
UNIT IV	**UNDER GROUND CABLES**	**09**
Underground cables – Types of cables – Construction of single core and 3 core cables – Insulation Resistance – Potential Gradient – Capacitance of Single-core and 3 core cables – Grading of cables – Power factor and heating of cables – DC cables.		
UNIT V	**DISTRIBUTION SYSTEMS**	**09**
Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions – Techniques of Voltage Control and Power factor improvement – Distribution Loss –Types of Substations – Methods of Grounding – Trends in Transmission and Distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).		
		TOTAL :45 PERIODS

OUTCOMES: After completion of this course, the student will be able to:	
1	Explain the importance and the functioning of transmission line parameters.
2	Demonstrate the performance of Transmission lines.
3	Explain the importance of distribution of the electric power in power system.
4	Identify the Underground cables
5	Familiarise with the function of different components used in Transmission and Distribution levels of power system and Modelling of these components.

TEXTBOOKS :	
1	D.P.Kothari, I.J. Nagarath, "Power System Engineering", Mc Graw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.
2	C.L.Wadhwa, "Electrical Power Systems", New Academic Science Ltd, 2009.
3	S.N. Singh, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.

REFERENCES :	
1	*B.R.Gupta, "Power System Analysis and Design", S. Chand, New Delhi, Fifth Edition, 2008.*
2	*Luces M.Fualken berry, Walter Coffer, "Electrical Power Distribution and Transmission", Pearson Education, 2007.*
3	*Arun Ingole, "Power Transmission and Distribution" Pearson Education, 2017*
4	*J.Brian, Hardy and Colin R.Bayliss, "Transmission and Distribution in Electrical*

	Engineering", Newnes; Fourth Edition, 2012.
5	*G.Ramamurthy, "Handbook of Electrical Power Distribution," Universities Press, 2013.*
6	*V.K.Mehta, Rohit Mehta, "Principles of Power System", S. Chand & Company Ltd, New Delhi, 2013*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPC305	**ELECTRICAL MACHINES LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

OBJECTIVES :

- To expose the students to the operation of various D.C. generators and give them experimental skill.
- To expose the students to the operation of various D.C. motors and give them experimental skill.
- To expose the students to the operation transformers and give them experimental skill to find the efficiency , losses and to draw the equivalent circuit
- To study the various methods of regulation calculation of alternator.
- To estimate the various losses takes place in Induction Motor and to study the load test methods to arrive at their performance.

LISTOFEXPERIMENTS:

1. Study of DC and AC Starters.
2. Open circuit and load characteristics of D.C shunt generator.
3. Load test on D.C shunt and Series Motor.

4. Load test on Alternator.
5. Swinburne's test and speed control of D.C shunt motor
6. Hopkinson's test on D.C. Motor generation set.
7. Load test on single phase and three phase transformer.
8.Open circuit and short circuit tests on single phase transformer.
9. Load test on single phase induction motor.
10. Noloadandblockedrotortestsonthreephaseinductionmotor.
11. Load test on Three phase induction motor.
12. V-Curve and inverted V-Curve of synchronous Motor.

LISTOFEQUIPMENTSFORABATCHOF30STUDENTS:

1.DCShuntMotor withLoadingArrangement–3Nos
2.SinglePhaseTransformer –4Nos
3. DC Series Motor with Loading Arrangement–1 No
4.Three Phase Induction Motor with Loading Arrangement–2 Nos
5. Single Phase Induction Motor with Loading Arrangement–1 No.
6. DC Shunt Motor Coupled With DC Shunt Generator–1 No
7.Tachometer -Digital/Analog–8Nos
8.Single Phase Auto Transformer – 2 Nos
9. Three Phase Auto Transformer–1 No
10.Single Phase Resistive Loading Bank –2 Nos
11. Three Phase ResistiveLoadingBank.–2 Nos
12.SPST switch–2Nos
13. Single Phase Transformer -1No
14. Three Phase Transformer -1 No
15.Three Phase Alternator -1 No

TOTAL : 45 PERIODS

OUTCOMES:

•	Able to draw the characteristics of DC Generators and Motors and determine the losses and efficiency.
•	Able to draw the equivalent circuit and characteristics of transformers and determine the losses and efficiency.
•	Able to draw the characteristics of Induction Motors and determine the losses and efficiency.
•	Able to draw the characteristics of Synchronous Motors and Alternators and determine the Voltage regulation and efficiency.

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

IV SEMESTER

18PTEPC401	PROTECTION AND SWITCHGEAR	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Understand the different components of a protection system.
- To Evaluate fault current due to different types of fault in a network.
- To Understand the protection schemes for different power system components.
- To Understand the basic principles of digital protection.
- To Understand system protection schemes, and the use of wide-area measurements.

UNIT I	INTRODUCTION TO PROTECTION SCHEMES	9

Principles of Power System Protection – Relays – Instrument transformers – Circuit Breakers – Types of Circuit Breakers – Attributes of Protection schemes – Back-up Protection.

UNIT II	FAULTS AND OVERCURRENT PROTECTION	9

Review of Fault Analysis – Sequence Networks – Introduction to Over current Protection – Over current relay co-ordination.

UNIT III	EQUIPMENT PROTECTION SCHEMES	9

Directional, Distance, Differential protection – Transformer and Generator protection – Bus bar Protection – Bus Bar arrangement schemes – Effect of Power Swings on Distance Relaying

UNIT IV	DIGITAL PROTECTION	9

Computer-aided protection – Fourier analysis and estimation of Phasors from DFT – Sampling, aliasing issues – Under-frequency, under-voltage and df/dt relays – Out-of-step protection – Synchro-

phasors – Phasor Measurement Units and Wide-Area Measurement Systems (WAMS) – Application of WAMS for improving protection systems		
UNIT V	**MODELLING AND SIMULATION OF PROTECTION**	**9**
CT/PT Modelling and standards – Simulation of transients using Power system softwares – Relay Testing – Hardware and Software Simulation of Air and Vacuum Circuit Breakers		
		TOTAL : 45 PERIODS

OUTCOMES:	At the end of this course, students will able to
1.	Apply relays and circuit breakers in various networks to ensure the protection
2.	Apply protection techniques to mitigate overcurrents
3.	Apply protection techniques to various electrical equipments
4.	Design numerical protective relays for protection
5.	Design and simulate various protective relays

TEXT BOOKS:

1.	J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.
2.	Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.

REFERENCES:

1.	*A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.*
2.	*A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.*
3.	*D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.*
4.	*Sunil S.Rao, 'Switchgear And Protection', Khanna Publishers, New Delhi, 2008.*
5.	*Ravindra P.Singh, ' Switchgear And Power System Protection', PHI Learning Private Ltd., New Delhi, 2009.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPC402	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:	
•	Understand the differences between signal level and power level devices.
•	Analyse controlled rectifier circuits.
•	Analyse the operation of DC-DC choppers, AC-AC converters.
•	Analyse the operation of AC voltage controllers and cyclo converters.
•	Analyse the operation of voltage source inverters.

UNIT I	POWER SWITCHING DEVICES	9

Diode – BJT – Thyristor – MOSFET – IGBT – I-V Characteristics – Firing circuit for thyristor – Voltage and current commutation of a thyristor – Gate drive circuits for MOSFET and IGBT.

UNIT II	THYRISTOR RECTIFIERS	9

Single-phase half-wave and full-wave rectifiers – Single-phase full-bridge thyristor rectifier with R-load and highly inductive load – Three-phase full-bridge thyristor rectifier with R-load and highly inductive load – Input current wave shape and power factor – SMPS (Flyback, Forward and Half Bridge methods).

UNIT III	DC – DC CONVERTERS	9

DC-DC buck converter – Elementary chopper with an active switch and diode – Concepts of duty ratio and average voltage – Power circuit of a buck converter – Analysis and waveforms at steady state – Duty ratio control of output voltage – Power circuit of a boost converter – Analysis and waveforms at steady state – Relation between duty ratio and average output voltage.

UNIT IV	AC-AC CONVERTERS	9

Single phase and Three phase AC voltage controllers – Control strategy – Power Factor Control – Multistage sequence control – Single phase Cyclo converters – Single phase Cyclo converters – Introduction to Matrix converters

UNIT V	VOLTAGE SOURCE INVERTER	9

Single-phase voltage source inverter – Switch states and instantaneous output voltage – Square wave operation of the inverter – Concept of average voltage over a switching cycle – Bipolar sinusoidal modulation and unipolar sinusoidal modulation – Modulation index and output voltage –Three-phase voltage source inverter – Switch states – Instantaneous output voltages – Average output voltages over a sub-cycle – Three-phase sinusoidal modulation	
TOTAL : 45 PERIODS	
OUTCOMES:	At the end of this course, students will able to
1.	Utilize the various power semiconductor devices in various circuits
2.	Apply thyristor convertors in power circuits and analyze the performance
3.	Apply DC - DC convertors in power circuits and analyze the performance
4.	Apply AC - AC convertors in power circuits and analyze the performance
5.	Apply voltage source inverters in power circuits and analyze the performance
TEXT BOOKS:	
1.	M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
2.	N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
REFERENCES:	
1.	*R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007*
2.	*L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.*
3.	*P.C.Sen, "Principles of Electrical Machines and Power Electronics", John-Wiley & Sons, New york.*
4.	*P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition, 2003.*
5.	*Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPC403	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic functional elements of instrumentation
- To understand the fundamentals of electrical and electronic instruments
- To compare between various measurement techniques
- To understand the operation of various storage and display devices
- To understand the operation of various transducers and the data acquisition systems

UNIT I	INTRODUCTION	09

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration – Principle and types of analog and digital voltmeters, ammeters.

UNIT II	ELECTRICAL AND ELECTRONIC INSTRUMENTS	09

Principle and types of multi meters – Single and three phase watt meters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III	COMPARATIVE METHODS OF MEASUREMENTS	09

D.C potentiometers – D.C (Wheat stone, Kelvin and Kelvin Double bridge) – A.C bridges (Maxwell, Anderson and Schering bridges) – Transformer ratio bridges – Self-balancing bridges – Interference & screening – Multiple earth and earth loops – Electrostatic and electromagnetic Interference – Grounding techniques.

UNIT IV	STORAGE AND DISPLAY DEVICES	09

Magnetic disk and tape – Recorders – Digital plotters and printers – CRT display – Digital CRO – LED, LCD & Dot matrix display – TFT&OLED-Data Loggers.

UNIT V	TRANSDUCERS AND DATA ACQUISITION SYSTEMS	09

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart sensors – Thermal Imagers.	
TOTAL :45 PERIODS	
OUTCOMES: After completion of this course, the student will be able to:	
1.	Explain the basic functional elements of instrumentation
2.	Explain the concepts of Fundamentals of electrical and electronic instruments
3.	Compare between various measurement techniques
4.	Explain the operation of various storage and display devices
5.	Explain the operation of various transducers and the data acquisition systems
TEXTBOOKS :	
1	A.K. Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co, 2010.
2	J. B. Gupta, "A Course in Electronic and Electrical Measurements", S. K. Kataria & Sons, Delhi, 2013.
3	Doebelin E.O. and Manik D.N., "Measurement Systems – Applications and Design", Special Indian Edition, McGraw Hill Education Pvt. Ltd., 2007.
REFERENCES :	
1	*H.S. Kalsi, "Electronic Instrumentation", McGraw Hill, III Edition 2010*
2	*D.V.S. Murthy, "Transducers and Instrumentation", Prentice Hall of India Pvt Ltd, 2015.*
3	*David Bell, "Electronic Instrumentation & Measurements", Oxford University Press,2013.*
4	*Martin Reissland, "Electrical Measurements", New Age International (P) Ltd., Delhi, 2001.*
5	*Alan. S. Morris, "Principles of Measurements and Instrumentation", 2nd Edition, Prentice Hall of India, 2003.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPC404	POWER SYSTEM ANALYSIS	L	T	P	C
		2	1	0	3
OBJECTIVES:					
•	To model the power system under steady state operating condition.				
•	To apply numerical methods to solve the power flow problem.				
•	To model and analyse the system under faulted conditions for balanced faults				
•	To model and analyse the system under faulted conditions for unbalanced faults				
•	To model and analyse the transient behaviour of power system when it is subjected to a fault				
UNIT I	**INTRODUCTION**		**9**		
Need for system planning and operational studies – basic components of a power system.- Introduction to restructuring - Single line diagram – per phase and per unit analysis – Generator - transformer – transmission line and load representation for different power system studies.- Primitive network - construction of Y-bus using inspection and singular transformation methods – z-bus.					
UNIT II	**POWER FLOW ANALYSIS**		**9**		
Importance of power flow analysis in planning and operation of power systems - statement of power flow problem - classification of buses - development of power flow model in complex variables form - iterative solution using Gauss-Seidel method - Q-limit check for voltage controlled buses – power flow model in polar form - iterative solution using Newton-Raphson method .					
UNIT III	**FAULT ANALYSIS – BALANCED FAULTS**		**9**		
Importance of short circuit analysis - assumptions in fault analysis - analysis using Thevenin's theorem - Z-bus building algorithm - fault analysis using Z-bus – computations of short circuit capacity, post fault voltage and currents.					
UNIT IV	**FAULT ANALYSIS – UNBALANCED FAULTS**		**9**		
Introduction to symmetrical components – sequence impedances – sequence circuits of synchronous machine, transformer and transmission lines - sequence networks analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem and Z-bus matrix.					
UNIT V	**STABILITY ANALYSIS**		**9**		

Importance of stability analysis in power system planning and operation - classification of power system stability - angle and voltage stability – Single Machine Infinite Bus (SMIB) system: Development of swing equation - equal area criterion - determination of critical clearing angle and time – solution of swing equation by modified Euler method and Runge-Kutta fourth order method.	
	TOTAL : 45 PERIODS
OUTCOMES: After completion of this course, the student will be able to:	
1.	Explain the power system operation and control.
2.	Apply the various power flow methods for power system optimization problems.
3.	Analyze the balanced faults for various power systems to design protective devices.
4.	Analyze the Unbalanced faults for various power systems.
5.	Analyze the stability of single machine and Multi machine infinite bus system.
TEXT BOOKS:	
1.	Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition,2011.
2.	John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', Tata McGraw-Hill, Sixth reprint, 2010.
REFERENCES:	
1.	*Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.*
2.	*Kundur P., 'Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi,10th reprint, 2010.*
3.	*Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.*
4.	*J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, ' Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.*
5.	*P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan, ' Electrical Power Systems Analysis, Security and Deregulation', PHI Learning Private Limited, New Delhi, 2012.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPC405	CONTROL AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To analysis and design of controllers, stability
- To design and test the various electrical parameters
- To design the different types Compensators and Modelling of Systems

LISTOFEXPERIMENTS

CONTROL SYSTEM

1. P, PI and PID controllers
2. Stability Analysis
3. Modelling of Systems – Machines, Sensors and Transducers (TF &SS Analysis)
4. Design of Lag, Lead and Lag-Lead Compensators
5. Position Control Systems
6. Synchro-Transmitter- Receiver and Characteristics
7. Simulation of Control Systems by Mathematical development tools.
8. Process Simulation.

INSTRUMENTATION:

9. Bridge Networks –AC and DC Bridges
10. Dynamics of Sensors/Transducers
    a. Temperature
    b. Pressure
    c. Displacement
    d. optical
    e. Strain

f. Flow

11. Power and Energy Measurement
12. Signal Conditioning
    a. Instrumentation Amplifier
    b. Analog – Digital and Digital –Analog converters (ADC and DACs)

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CONTROL SYSTEMS:

1. PID kit – 1 No.
   DSO – 1 No.
   CRO Probe – 2 nos
2. Personal computers
3. DC motor – 1 No.
   Generator – 1 No. Rheostats – 2 nos
   Ammeters Voltmeters
   Connecting wires (3/20)
4. CRO 30MHz – 1 No.
   2MHz Function Generator – 1No.
5. Position Control Systems Kit (with manual) – 1 No., Tacho Generator Coupling set
6. AC Synchro transmitter& receiver – 1No.
   Digital multi meters

INSTRUMENTATION:

7. R, L, C Bridge kit (with manual)
8. a) Electric heater – 1No.
   Thermometer – 1No.Thermistor (silicon type) RTD nickel type – 1No.

   b) 30 psi Pressure chamber (complete set) – 1No. Current generator (0 – 20mA)
   Air foot pump – 1 No. (with necessary connecting tubes)

   c) LVDT20mm core length movable type – 1No. CRO 30MHz – 1No.

   d) Optical sensor – 1 No. Light source

   e) Strain Gauge Kit with Handy lever beam – 1No.
   100gm weights – 10 nos

   f) Flow measurement Trainer kit – 1 No.
   (1/2 HP Motor, Water tank, Digital Milliammeter, complete set)
9. Single phase Auto transformer – 1No.
   Watthour meter (energy meter) – 1No. Ammeter
   Voltmeter Rheostat Stop watch

Connecting wires (3/20) 10. IC Transistor kit – 1No.	
	TOTAL:45 PERIODS
OUTCOMES:	After successful completion of the course students able to
1.	Analysis and design of controllers, stability
2.	Design and test the various electrical parameters
3.	Design the different types Compensators and Modelling of Systems
4.	Design and study the various controllers
5.	Simulate and analyse the various graphical methods in time and frequency response

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

V SEMESTER

18PTEPC501	MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the Architecture of uP8085 & uC 8051
- To study the addressing modes & instruction set of 8085 & 8051
- To introduce the need & use of Interrupt structure 8085 & 8051.
- To develop skill in simple applications development with programming 8085 & 8051
- To introduce commonly used peripheral / interfacing

UNIT I	INTRODUCTION TO MICROPROCESSORS	9

Hardware Architecture pin outs - Signals – Memory interfacing – I/O ports and data transfer concepts– Timing Diagram – Interrupt structure. Introduction to 8086 processor (Architecture and modes of operation only).

UNIT II	PROGRAMMING OF 8085 PROCESSOR	9

Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Lookup table - Subroutine instructions - stack.

UNIT III	8051 MICRO CONTROLLER	9

Functional block diagram - Instruction format and addressing modes – Timing Diagram Interrupt structure – Timer –I/O ports – Serial communication.

UNIT IV	PERIPHERAL INTERFACING-8051	9

Study of Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8253 Timer/ Counter-A/D and D/A converter interfacing, interfacing with LCD, digital IOs, keypad and memory.

UNIT V	MICRO CONTROLLER PROGRAMMING AND APPLICATIONS	9

Data Transfer, Manipulation, Control & I/O instructions – Simple programming exercises key board and display interface – Design of PID controller - Closed loop control of servo motor - Stepper motor control - Washing Machine Control.

TOTAL : 45 PERIODS

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

1. Explain the architecture of Microprocessors and its blocks.

2.	Demonstrate the program for various functions using 8085 processor.
3.	Explain the architecture, Program structure, and peripheral interfacing of 8051 Microcontrollers.
4.	Apply the 8051 microcontroller into various applications.
5.	Understand the micro controller programming and applications

TEXT BOOKS:

1.	Ramesh Gaonkar, 'Microprocessor Architecture Programming and Application', CBS Publishers 2011.
2.	B.Ram, "Fundamentals of Microprocessor and Microcontrollers", Dhanpat Rai Publications, 2015
3.	Senthilkumar N. and Saravanan M. "Microprocessor and Microcontrollers", Oxford University Press, 2011

REFERENCES:

1.	*Ankaj Gupta "Microcontroller and Embedded System" S.K.Kataria and Sons Publishers 2013*
2.	*Muhammad Ali Mazidi& Janice GilliMazidi, R.D.Kinely "The 8051 Micro Controller and Embedded Systems" (Using Assembly Language and C), PHI Pearson Education, 2011*
3.	*The 8088 & 8086 Microprocessors , Walter A Tribal & Avtar Singh, Pearson, 200*
4.	*Singh B.P., Renu Singh "Advanced Microprocessors and Microcontrollers", New Age International Private Limited, 2009.*
5.	*Krishna Kant "Microprocessor and Microcontrollers" Eastern Company Edition, Prentice – Hall of India, New Delhi, 2007*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPC502	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To have an overview of power system operation and control.
- To study the economic operation of power system
- To model power-frequency dynamics and to design power-frequency controller.
- To model reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
- To teach about SCADA and its application for real time operation and control of power systems

UNIT I	CHARACTERISTICS OF LOADS	9

Basics of Power system control and operation – Real and Reactive power of Loads - System load variation – Load characteristics – Load curves and Load Duration curve – load factor and diversity factor - Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves – Overview of system operation: Load forecasting, techniques of forecasting, Importance of load forecasting.

UNIT II	POWER SYSTEM OPERATION	9

Statement of Unit Commitment problem - Constraints - Solution methods: Priority-list methods, forward dynamic programming approach – Formulation of economic Dispatch problem with and without losses - Solution by direct method and λ-iteration method. - Base point and participation factors – Hydrothermal scheduling problem – Short term and long term model and algorithm – Dynamic Programming solution methods for hydrothermal scheduling (Qualitative treatment only).

UNIT III	ACTIVE POWER FREQUENCY CONTROL	9

Basics of speed governing mechanism and Modelling- speed-load characteristics–Parallel operation of Alternators- LFC control of a single-area system–Static and Dynamic characteristics – PI controller in LFC– LFC in Two area system – Static analysis with uncontrolled case- tie line with frequency bias control- State model– LFC with Economic dispatch controller.

UNIT IV	REACTIVE POWER VOLTAGE CONTROL	9

Generation, Absorption and control of reactive power– Modelling of excitation systems – Static and dynamic characteristics-Stability compensation - Secondary voltage control – Tap changing transformers for voltage control – FACTS applications to reactive power control: STATCOM, SVC, TCS and TSC.

UNIT V	SMART POWER CONTROL	9

Need for smart control of power systems –concept of energy control centre- functions-system monitoring –data acquisition and control-system hardware configuration–SCADA and EMS functions-network topology-state estimation–WLSE-Contingency Analysis-state transition diagram showing various state transitions and control strategies. Recent trends in power system control.	
	TOTAL : 45 PERIODS
OUTCOMES:	After successful completion of the course students able to
1.	Analyse the loads and apply forecasting methods for power system restructuring.
2.	Operate the generating units in an efficient way to reduce fuel cost.
3.	Design load frequency controller to regulate the frequency and speed.
4.	Design the excitation systems with appropriate voltage controllers to regulate voltage and compensate reactive power.
5.	Apply smart techniques in power system security.
TEXT BOOKS:	
1.	Allen. J.Woodand BruceF. Wollenberg, 'PowerGeneration, Operation and Control', John Wiley &Sons,Inc.,2003.
2.	Abhijit Chakrabarti, Sunita Halder, 'Power System Analysis Operation and Control', PHIlearning Pvt.Ltd., NewDelhi, ThirdEdition,2010.
REFERENCES:	
1.	*Badri Ram, D. N. Vishwakarma ,'Power System Protection and Switchgear' Tata McGraw-Hill Education, 2001.*
2.	*Kundur P., 'Power System Stability and Control, Tata McGraw' Hill Education Pvt. Ltd., New Delhi ,10threprint, 2010.*
3.	*N.V.Ramana, "Power System Operation and Control," Pearson,2011.*
4.	*Sunil S Rao, "Switch gear Protection And Power Systems (Theory, Practice & Solved Problems)", Khanna Publishers,2008*
5.	*M. L. Soni, P. V. Gupta, U. S. Bhatnagar ,"A Course in Electrical Power" Dhanpat Rai, 1987.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPC503	ELECTRICAL MACHINE DESIGN	L	T	P	C
		2	1	0	3

OBJECTIVES:

- To study mmf calculation and thermal rating of various types of electrical machines
- To design armature and field systems for D.C. machines
- To design core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines.
- To design stator and rotor of synchronous machines and study their thermal behaviour.

UNIT I	INTRODUCTION	9

Major considerations in Electrical Machine Design - Electrical Engineering Materials - Space factor – Choice of Specific Electrical and Magnetic loadings – Thermal consideration - Heat Dissipation - Temperature gradient in cores slots and windings - Rating of machines – Standard specifications. Introduction to Computer aided Design in Electrical Machines (Simple Treatment).

UNIT II	DC MACHINES	9

Output Equations – Main Dimensions - Magnetic circuit calculations - Carter's Coefficient – Net length of Iron –Real & Apparent flux densities – Selection of number of poles – Design of Armature – Design of commutator and brushes – Design of field winding.

UNIT III	TRANSFORMERS	9

Output Equations – Main Dimensions - KVA output for single and three phase transformers – Window space factor – Design of core and windings - Overall dimensions – No load current– Temperature rise in Transformers – Design of Tank with cooling tubes - Methods of cooling of Transformers.

UNIT IV	INDUCTION MOTORS	9

Output equation of Induction motor – Main dimensions – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor -– Magnetic leakage calculations – Leakage reactance of polyphase machines - Magnetizing current - Short circuit current .

UNIT V	SYNCHRONOUS MACHINES	9
Output equations – choice of loadings – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Design of field winding – Design of turbo alternators – Rotor design.		
	TOTAL : 45 PERIODS	

OUTCOMES:	After successful completion of the course students able to
1.	Formulate Specific Electrical and Magnetic loadings for various electrical DC and AC machines.
2.	Devise main dimensions (D, L) of armature and field systems for D.C. machines.
3.	Design overall Dimensions of single and three phase transformers core, windings and cooling systems for transformers
4.	Design main dimensions of squirrel cage and Slip ring induction machines.
5.	Design main dimensions of Synchronous machines.

TEXT BOOKS:

1.	Sawhney A.K., *"*A Course in Electrical Machine Design*",* Dhanpat Rai & Sons, New Delhi, 2006.
2.	Sen S.K., "Principles of Electrical Machine Designs with Computer Programmes", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2009.

REFERENCES:

1.	*Say.M.G, "The Performance and Design of Alternating current Machines", Isaac Pitman & sons Limited, 1995.*
2.	*Shanmugasundaram A., Gangadharan G. and Palani R., "Electrical Machine Design Data Book", New Age International Pvt. Ltd., Reprint 2007.*
3.	*A.Shanmuga Sundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007*
4.	*R.K.Agarwal " Principles of Electrical Machine Design" Esskay Publications, Delhi, 2002.*
5.	*"Electrical machine design" Balbir singh Brite Publications, Pune*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPC505	POWER ELECTRONICS AND POWER SYSTEM LABORATORY	L	T	P	C

	0	**0**	**3**	**1.5**

OBJECTIVES:	
•	To provide Experiment test bench to learn the characteristics of power semiconductor devices
•	To provide hands on experience with power electronic AC to DC converter and dc to DC converter to determine the control characteristics
•	To provide hands on experience with various power electronic inverters design and testing
•	To perform the Load flow, Fault analysis and stability analysis in Power system
•	To Model and simulate the Load frequency control of Single Area system

LIST OF EXPERIMENTS

1. Characteristics of Power semiconductor devices.
2. Determination of Control Characteristics of AC to DC fully controlled three phase converter .
3. Determination of Control Characteristics of Step down and Step up chopper.
4. IGBT based PWM three phase inverter.
5. AC Voltage Controller.
6. Cycloconverter.
7. Design and simulation of Transmission Lines.
8. Formation of Network Matrixes.
9. Load flow Analysis using Gauss Seidal method.
10. Simulation of Faults.
11. Load Frequency control of Single Area System.
12. Stability Analysis of Single Machine Infinite bus system.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Device characteristics(for SCR, MOSFET, TRIAC and IGBT kit with built in / discrete power supply and meters) - 2 each
2. Single phase SCR based fully controlled converter along with built-in / separate / firing circuit / module and meter – 2 each
3. MOSFET based step up and step down choppers (Built in/ Discrete) – 1 each
4. IGBT based three phase PWM inverter module / Discrete Component – 2
5. SCR &TRIAC based 1 phase AC controller along with lamp or rheostat load - 2
6. Cyclo converter kit with firing module – 2
7. Dual regulated Dc power supply with common ground
8. Cathode ray Oscilloscope –10

9. Isolation Transformer – 5 10. Single phase Auto transformer –3 11. Components (Inductance, Capacitance) 3 set for each 12. Multimeter – 5 13.Power system software Package (MATLAB, MiPower etc.,)
TOTAL:45 PERIODS

OUTCOMES:	After successful completion of the course students able to
1.	Compare the characteristics of various power semiconductor devices.
2.	Apply the Power Electronic Circuits in Power System.
3.	Model and simulate the Power Networks.
4.	Design the Load Frequency controller.

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

VI SEMESTER

18PTEPC601	**SPECIAL ELECTRICAL MACHINES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:		
•	To impart knowledge on Construction, principle of operation and performance of synchronous reluctance motors	
•	To study the Construction, principle of operation, control and performance of stepping motors	
•	To study the Construction, principle of operation, control and performance of switched reluctance motors	
•	To impart knowledge on the Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors	
•	To impart knowledge on the Construction, principle of operation and performance of Permanent magnet synchronous motors.	
UNIT I	**SYNCHRONOUS RELUCTANCE MOTORS**	**9**
Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance Motors – Voltage and Torque Equations - Phasor diagram - performance characteristics – Applications		
UNIT II	**STEPPER MOTORS**	**9**
Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Torque equations – Modes of excitation – Characteristics – Drive circuits – Microprocessor control of stepper motors – Closed loop control-Concept of lead angle– Applications		
UNIT III	**SWITCHED RELUCTANCE MOTORS** (SRM)	**9**
Constructional features – Rotary and Linear SRM - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensor less operation – Characteristics and Closed loop control – Applications		
UNIT IV	**PERMANENT MAGNET BRUSHLESS D.C. MOTORS**	**9**
Permanent Magnet materials – Minor hysteresis loop and recoil line-Magnetic Characteristics – Permeance coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation - Power Converter Circuits and their controllers – Motor characteristics and control– Applications		
UNIT V	**PERMANENT MAGNET SYNCHRONOUS MOTORS** (PMSM)	**9**
Principle of operation – Ideal PMSM – EMF and Torque equations – Armature MMF – Synchronous Reactance – Sine wave motor with practical windings - Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements– Applications.		
	TOTAL : 45 PERIODS	

OUTCOMES:	After successful completion of the course students able to
1.	Explain about the Constructional features of synchronous Reluctance Motors
2.	Explain about the Constructional features of stepper motor
3.	Explain about the Constructional features of switched Reluctance Motors
4.	Explain about the Constructional features of permanent magnet brushless D.C. Motors
5.	Explain about the Constructional features of permanent magnet Synchronous Motors

TEXT BOOKS:

1	K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008
2	T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press,Oxford, 1989

REFERENCES:

1.	*R.Krishnan, 'Switched Reluctance Motor Drives – Modelling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001..*
2.	*. P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus London, 1982*
3.	*T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.*
4.	*E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.*
5.	*T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3			2						2		2		

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPC602	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the 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	9

Causes of over voltages and its effects on power system–Lightning, switching surges and temporary over voltages, Corona and its effects–Reflection and Refraction of Travelling waves- Protection against over voltages

UNIT II	DIELECTRIC BREAKDOWN	9

Gaseous break down in uniform and non-uniform fields–Corona discharges–Vacuum breakdown– Conduction and break down in pure and commercial liquids, Maintenance of oil Quality –Breakdown mechanisms in solid and composite dielectrics.

UNIT III	GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS	9

Generation of High DC: Voltage doubler, Voltage multiplier circuits and Van de Graff generator, Generation of High AC: Cascade Transformer and Resonant transformer, Circuits for impulse voltages and currents generation- Tripping and control of impulse generator.

UNIT IV	MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS	9

HighResistancewithseriesammeter–Dividers,Resistance,CapacitanceandMixeddividers- 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	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.	
	TOTAL : 45 PERIODS
OUTCOMES:	After successful completion of the course students able to
1.	Explain the causes and effects of over voltages and transients
2.	Explain the electrical breakdown on various medium
3.	Design the generation circuit of overvoltage, impulse voltage and Current.
4.	Measure the overvoltage and current using various components.
5.	Test the electrical apparatus against over voltages and impulse current.
TEXT BOOKS:	
1.	M.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 , NewDelhi,2005.
REFERENCES:	
1.	*L.L.Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.*
2.	*C.L.Wadhwa, 'High voltage Engineering', NewAge International Publishers,ThirdEdition,2010*
3.	*Subir Ray, 'An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.*
4	*E.Kuffel,W.S.Zaengl,J.Kuffel,'High Voltage Engineering fundamentals'Newnes Publisher*
5.	*Farouk.A.M. Rizk, Giao N. Trinh, 'High Voltage Engineering' CRC Press.*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	2				2					1			2		1
CO2		2	3								2	1		2	
CO3		2	3								2	1		1	2
CO4	2				1					1	2		2		
CO5		2	3							2	1			2	1

1-Low, 2-Moderate (Medium), 3-High

18PTEPC605	MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:	
•	To provide training on programming of microprocessors and microcontrollers and understand the interface requirements.
•	To study the architecture and addressing modes of 8085 & 8051
•	To study the need and use of Interrupt structure 8085 & 8051.
•	To apply the 8085 microprocessor for various applications
•	To apply the 8051 microcontroller for various applications

LISTOFEXPERIMENTS

1. Simple arithmetic operations: addition / subtraction / multiplication / division.
2. Programming with control instructions:
   - (i) Ascending / Descending order, Maximum / Minimum of numbers
   - (ii) Programs using Rotate instructions
   - (iii) Hex / ASCII / BCD code conversions.
3. Interface Experiments: with 8085
   - (i) A/D Interfacing. & D /A Interfacing.
4. Traffic light controller.
5. I/O Port / Serial communication
6. Programming Practices with Simulators/Emulators/open source
7. Read a key ,interface display
8. Demonstration of basic instructions with 8051 Micro controller execution, including: (i) Conditional jumps, looping
   - (ii) Calling subroutines.
9. ..Programming I/O Port 8051
   - (i) study on interface with A/D & D/A
   - (ii) study on interface with DC & AC motor .
10. Mini project development with processors.

LISTOFEQUIPMENTFORABATCHOF30STUDENTS:

Sl.No.	Description of Equipment	Quantity required
1.	8085 Microprocessor Trainer with Power Supply	15
2.	8051 Micro Controller Trainer Kit with power supply	15
3.	8255 Interface board	5
4.	8251 Interface board	5
5.	8259 Interface board	5
6.	8279 Keyboard / Display Interface board	5
7.	8254 timer counter	5
8.	ADC and DAC card	5
9.	AC & DC motor with Controller	5
10.	Traffic Light Control System	5

	TOTAL:45 PERIODS
OUTCOMES:	After successful completion of the course students able to
1.	Write the program for various functions using 8085 microprocessor.
2.	Write the program for various functions using 8085 microprocessor.
3.	Use of Interrupt structure 8085 & 8051
4.	Apply the 8085 microprocessor for various applications
5.	Apply the 8051 microcontroller for various applications

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

VII SEMESTER

18PTEPC701	ENERGY UTILIZATION CONSERVATION AND AUDITING	L	T	P	C
		3	0	0	3

OBJECTIVES:	
•	To study importance of energy and its various forms
•	To analyse energy management & audit
•	To analyse energy efficiency in electrical systems
•	To impart knowledge on energy efficiency in industrial systems
•	To Provide knowledge about various energy efficient technologies in electrical systems

UNIT I	ENERGY SCENARIO AND BASICS OF ENERGY AND ITS VARIOUS FORMS	10

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy Strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its Features.

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion

UNIT II	ENERGY MANAGEMENT & AUDIT	9

Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

UNIT III	ENERGY EFFICIENCY IN ELECTRICAL SYSTEMS	9

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with

energy efficient motors

UNIT IV	ENERGY EFFICIENCY IN INDUSTRIAL SYSTEMS	9

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation,

efficient system operation, flow control strategies and energy conservation opportunities Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.		
UNIT V	**ENERGY EFFICIENT TECHNOLOGIES IN ELECTRICAL SYSTEMS**	**8**
Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.		
	TOTAL : 45 PERIODS	

OUTCOMES:	After successful completion of the course students able to
1.	Explain the current energy scenario and importance of energy conservation
2.	Explain the concepts of energy management.
3.	Explain the methods of improving energy efficiency in different electrical systems
4.	Explain the concepts of different energy efficient devices
5.	Explain the concepts of different energy efficient technologies

TEXT BOOKS:

1	S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
2	Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
3	Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online).

REFERENCES:

1.	*Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)*
2.	*Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online).*
3.	Sivaganaraju.S "Utilization of Electrical Energy and Conservation"Pearson ,New Delhi
4.	*Paul O Callaghan, energy management,* McGraw Hill,New Delhi.
5.	*V.K.Mehta, Electrical power by Khanna Publishes New Delhi.*

COURSE ARTICULATION MATRIX

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

18PTEPR704	**PROJECT WORK**	**L**	**T**	**P**	**C**
		0	**0**	**9**	**4.5**

OBJECTIVES

- To provide opportunity to explore a problem or issue of particular personal or professional interest.
- To address the problem or issue through focused study and applied research under the direction of a faculty member.
- To synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems.

•	To improve ability to think critically and creatively, to solve practical problems,
•	To make reasoned and ethical decisions, and to communicate effectively.

It is intended to start the project work carry out both design and fabrication of an Electrical and Electronic device whose working can be demonstrated. The design, the fabrication and demonstration has to be carried out.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 135 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1	Identify the real time Engineering problems in their day to day life.
2	Apply the knowledge and skills acquired in their courses to a specific problem or issue
3	Think critically and creatively to address and help solve these professional or social issues and to further development.
4	Refine research skills and demonstrate their proficiency in written and oral communication skills.
5	Take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

PROFESSIONAL ELECTIVES

18PTEPE001	APPLIED SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:	
•	To expose the students to the concepts of feed forward neural networks.
•	To provide adequate knowledge about feedback neural networks
•	To provide adequate knowledge about fuzzy and neuro-fuzzy systems

•	To provide comprehensive knowledge of fuzzy logic control to real time systems.	
•	To provide adequate knowledge of genetic algorithms and its application to economic dispatch and unit commitment problems.	
UNIT I	**ARCHITECTURES–ANN**	**9**
Introduction–Biological neuron–Artificial neuron–Neuron model –Supervised and unsupervised learning-Single layer–Multi layer feed forward network–Learning algorithm-Perceptron Network-Back propagation Network.		
UNIT II	**NEURAL NETWORKS FOR CONTROL**	**9**
Feedback networks–Discrete time Hopfield networks– Transient response of continuous time system–Applications of artificial neural network-Process identification–Neuro controller for inverted pendulum.		
UNIT III	**FUZZY SYSTEMS**	**9**
Classical sets– Fuzzy sets –Fuzzy relations– Fuzzification – Defuzzification – Fuzzy rules – Membershipfunction–Knowledgebase–Decision-makinglogic–Introductiontoneurofuzzy system- Adaptive fuzzy system.		
UNIT IV	**APPLICATION OF FUZZY LOGIC SYSTEMS**	**9**
Fuzzy logic control: Homeheatingsystem-liquidlevelcontrol-aircraftlanding-invertedpendulum–fuzzyPIDcontrol, Fuzzy based motor control.		
UNIT V	**GENETIC ALGORITHMS**	**9**
Introduction-Gradient Search–Non-gradient search–Genetic Algorithms :binary and real representation schemes, selection methods, crossover and mutation operators for binary and real coding-constraint handling methods–applications to economic dispatch and unit commitment problems		
	TOTAL : 45 PERIODS	
OUTCOMES:	After successful completion of the course students able to	
1.	Design an algorithm for Artificial Neural Network Controller	
2.	Design a Genetic algorithm	
3.	Design an algorithm for Fuzzy Logic Controller	
4.	Apply Fuzzy Logic Controller for specific applications	

5.	Apply Genetic algorithm for specific applications
TEXT BOOKS:	
1.	Laurance Fausett, Englewood cliffs,N.J., 'Fundamentals of Neural Networks', PearsonEducation, 1992
2.	S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013.
REFERENCES:	
1.	*Simon Haykin, 'Neural Networks', Pearson Education,2003.*
2.	*Timothy J Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 1997.*
3.	*M.Gen and R,Cheng, Genetic algorithms and Optimization, Wiley Series in Engineering Design and Automation, 2000.*
4.	*Hagan, Demuth, Beale, "Neural Network Design", Cengage Learning, 2012.*
5.	*N.P.Padhy, "Artificial IntelligenceandIntelligentSystems",Oxford,2013*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE002	WIND AND SOLAR ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the design and control principles of Wind turbine.
- To understand the concepts of fixed speed and variable speed, wind energy conversion
- To analyze the grid integration issues in wind energy system.
- To learn the design of standalone PV system.
- To analyze the grid integration issues in PV system.

UNIT I	INTRODUCTION	09

Wind: Components of WECS - WECS schemes - Power obtained from wind -Sabinin's theory - Aerodynamics of Wind turbine. HAWT – VAWT - Thrust – Efficiency - Rotor selection - Tip speed ratio -Power Regulation.

Solar: Characteristics of sunlight–behaviour of solar cells–cell properties–PV cell interconnection

UNIT II	FIXED SPEED AND VARIABLE SPEED WIND	09

	SYSTEMS	
Generating Systems - Constant speed constant frequency systems - Choice of Generators - Deciding factors - Synchronous Generator - Squirrel Cage Induction Generator - Model of Wind Speed - Model wind turbine rotor - Drive Train model. Need of variable speed systems – Power - wind speed characteristics - Variable speed constant frequency systems synchronous generator – DFIG – PMSG - Variable speed generators modelling - Variable speed variable frequency schemes.		
UNIT III	**GRID CONNECTED WIND SYSTEMS**	**09**
Wind interconnection requirements –low-voltage ride through (LVRT) – ramp rate limitations, and supply of ancillary services for frequency and voltage control – current practices and industry trends wind inter connection impact on steady-state and dynamic performance of the power system including modelling issue.		
UNIT IV	**STANDALONE PV SYSTEM**	**09**
Solar modules–storage systems–power conditioning and regulation-MPPT-protection–Standalone PV systems design–sizing		
UNIT V	**GRID CONNECTED PV SYSTEMS**	**09**
PV systems in buildings–design issues for central power stations–safety–Economic aspect – Efficiency and performance- International PV programs – Synchronization issues		
		TOTAL :45 PERIODS

OUTCOMES: After completion of this course, the student will be able to:	
1	Explain the basic concepts of Wind and solar energy conversion system.
2	Develop the design of Fixed speed and Variable speed system
3	Explain about Grid connected Wind system.
4	Design a standalone PV system.
5	Explain about Grid integration issues and current practices of PV interconnections.

TEXT BOOKS:	
1.	L.L. Freris "Wind Energy conversion Systems", Prentice Hall,1990
2.	S.N.Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Sytems", Oxford University Press, 2010.
3.	Solanki C.S., "Solar Photovoltaics: Fundamentals, Technologies And Applications", PHI Learning Pvt. Ltd., 2015.
4.	Stuart R.Wenham, Martin A. Green, Muriel E. Watt and Richard Corkish, "Applied Photovoltaics", 2007, Earthscan, UK.

REFERENCES:	
1.	*Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006*
2.	*S.Heir "Grid Integration of WECS", Wiley 1998*
3.	*Eduardo Lorenzo G. Araujo, "Solar electricity engineering of photovoltaic systems", Progensa, 1994.*
4.	*Frank S. Barnes& Jonah G. Levine, "Large Energy storage Systems Handbook", CRC Press, 2011.*
5.	*McNeils, Frenkel, Desai, "Solar &Wind Energy Technologies", Wiley Eastern, 1990*
6.	*S.P.Sukhatme, "Solar Energy", Tata McGraw Hill, 1987*

7.	*G.D.Rai, "Non-Conventional Energy Sources",Khanna Publishers,2015*
8.	*NPTEL videos by IITs*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE003	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To Introduce various bio potential electrodes used in Biomedical Engineering
- To study the heart system and its measurements
- To study the measurement of electrical activity in neuromuscular system and brain
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I	FUNDAMENTALS OF BIOMEDICAL ENGINEERING	9

Brief description of musculoskeletal, endocrine, gastrointestinal, nervous, circulatory and respiratory systems; the nature of bioelectricity, action events of nerve; the origin of bio potentials. Basic components of a biomedical system-Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues - Basic mechanics of spinal column and limbs.

UNIT II	BIO POTENTIAL ELECTRODES	9

Signal acquisition; electrodes for biophysical sensing; electrode-electrolyte interface; skin preparation, electrode-skin interface and motion artifact; surface electrodes; microelectrodes; Internal electrodes; electrode arrays; electrodes for electric stimulation of tissues; electrode polarization, electrical interference problems in biopotential measurement; electrical safety.

UNIT III	THE HEART SYSTEM AND ITS MEASUREMENTS	9

The heart; electro conduction system of the heart; the ECG waveform; the standard lead system; the ECG preamplifier; ECG machines; Cardiac monitors; Transient protection; common-mode and other interference-reduction circuits, Measurement of blood pressure, spirometer – Photo Plethysmography, Body Plethysmography, finger-tip oxymeter, measurement of blood pCO2, pO2

UNIT IV	MEASUREMENT OF ELECTRICAL ACTIVITY IN NEUROMUSCULAR SYSTEM AND BRAIN	9

Neuron potential; muscle potential; electromyography (EMG); electroencephalography (EEG); EEG electrodes and the 10-20 system; EEG amplitude and frequency bands; the EEG system – simplified block diagram; preamplifiers and EEG system specifications; EEG diagnostic uses and sleep patterns; visual and auditory evoked potential recordings; EEG system artifacts.

UNIT V	IMAGING, LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES	9
Computer tomography – MRI – Ultrasonography – Endoscopy ,Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation.		
		TOTAL : 45 PERIODS

OUTCOMES:	After successful completion of the course students able to
•	Explain about electrical signal production and its conduction in human body.
•	Select proper electrode for signal pick up from human body
•	Trace cardiac waveform and characterise its condition
•	Trace brain waveform and characterise its condition
•	Explain about the different life saving, therapeutic and imaging bio medical systems its importance to patients

TEXT BOOKS:

1.	Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.
2.	Khandpur R.S, Handbook of Biomedical Instrumentation, , Tata McGraw-Hill, New Delhi, 2nd Edition, 2003

REFERENCES:

1.	*John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998*
2.	*Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.*
3.	*Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.*
4.	*M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.*
5.	*Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi,2007.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE004	**FUNDAMENTALS OF NANOSCIENCE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:	
•	To learn about basis of nanomaterial science
•	To learn about nanomaterial preparation methods
•	To learn about basis of nanomaterial science, preparation method and types
•	To learn about nanomaterial characterization techniques
•	To study various application fields of nano materials

UNITI	INTRODUCTION	9

Nano scale Science and Technology-Implications for Physics, Chemistry, Biology and Engineering- Classifications of nano structured materials-nano particles-quantum dots, nano wires-ultra-thin films- multi-layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties .Introduction to properties and motivation for study (qualitativeonly).

UNITII	GENERAL METHODS OF PREPARATION	9

Bottom-upSynthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNITIII	NANOMATERIALS	9

Nano forms of Carbon-Buckminster fullerene-graphene and carbon nano tube ,Single wall carbon Nano tubes(SWCNT) and Multi wall carbon nano tubes(MWCNT)-methods of synthesis(arc-growth, laser ablation,CVDroutes,PlasmaCVD),structure-propertyRelationshipsapplications-Nanometal oxides- ZnO, TiO2,MgO,ZrO2, NiO, nanoalumina, CaO,AgTiO2,Ferrites, Nanoclays- functionalizationandapplications-Quantumwires,Quantumdots-preparation,properties and applications.

UNITIV	CHARACTERIZATION TECHNIQUES	9

X-ray diffraction technique, Scanning Electron Microscopy- environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM,SPM, STM,SNOM,ESCA,SIMS-Nano indentation.

UNITV	APPLICATIONS	9

Nano Info Tech: Information storage- nano computer, molecular switch, super chip, nano crystal, Nano biotechology: nano probesinmedical diagnosticsand biotechnology,

Nanomedicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems(MEMS), Nano Electro Mechanical Systems(NEMS)-Nano sensors, nano crystallinesilver for bacterialinhibition, Nano particles for sunbarrier products- In Photostat, printing, solar cell, battery.	
	TOTAL:45PERIODS
OUTCOMES:	After successful completion of the course students able to
1.	Familiarize about the science of nanomaterial.
2.	Demonstrate the preparation of nanomaterial.
3.	Explain about nanomaterial.
4.	Develop knowledge in characteristic nanomaterial.
5.	Apply Nano Science into the applications.
TEXTBOOKS:	
1.	A.S.Edelsteinand, R.C.Cammearata,eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996
2.	N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces" ,2nd edition, Weinheim Cambridge,Wiley-VCH,2000.
REFERENCES:	
1.	*G Timp, "Nanotechnology", AIP press/Springer,1999*
2.	*Akhlesh Lakhtakia, "The HandBook of Nano Technology, Nanometer Structure, Theory, Modelling and Simulations". Prentice-Hall of India(P) Ltd,NewDelhi,2007.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE005	ADVANCED CONTROL SYSTEM	L	T	P	C
		2	1	0	3

OBJECTIVES:	
•	To provide knowledge on design in state variable form
•	To provide knowledge in phase plane analysis
•	To give basic knowledge in describing function analysis

•	To study the design of optimal controller
•	To study the design of optimal estimator including Kalman Filter

UNIT I	**STATE VARIABLE CONTROLLER DESIGN**	**9**

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control.

UNIT II	**PHASE PLANE ANALYSIS**	**9**

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III	**DESCRIBING FUNCTION ANALYSIS**	**9**

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations-Lyapnov and Popov Stability.

UNIT IV	**OPTIMAL CONTROL**	**9**

Introduction –Continuous Time Linear State Regulator – Discrete Time Linear State Regulator – Solution of Ricatti'sequation.

UNIT V	**OPTIMAL ESTIMATION**	**9**

Optimal estimation – Kalman- Bucy Filter-Solution by duality principle-Discrete systems-Kalman Filter.

	TOTAL : 45 PERIODS

OUTCOMES: After successful completion of the course students able to

1.	Design the controller in state variable form.
2.	Explain the concepts about the phase plane analysis.
3.	Explain the concepts about the describing function analysis.
4.	Design of optimal controller.
5.	Design of optimal estimator including Kalman Filter.

TEXT BOOKS:

1.	M.Gopal, "Digital Control & State Variable Methods", Tata McGraw Hill, 4th EDITION, 2012
2.	I.J. Nagrath and M.Gopal, "Control Systems Engineering", New Age International Publishers, 5th Edition, 2010.

REFERNCES:	
1.	*K.Ogatta, "Discrete time control system", PHI, 2010.*
2.	*B.C.Kuo," Digital Control Systems", SRL Publication, 1997.*
3.	*M. Gopal, "Control Systems Principles and Design", TATA Mcgraw hill, 3 Edition, 2010*
4.	*M.Gopal," Modern control system theory", New Age International Publishers, 2002*
5.	*Richard C. Dorf, "Modern control systems",8th Edition, Addison Wesley, 2012.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE006	POWER QUALITY AND FACTS	L	T	P	C
		3	0	0	3

OBJECTIVES:	
•	To introduce the power quality problem
•	To educate on production of voltages sags, over voltages and harmonics and methods of control.
•	To study the sources and effect of harmonics in power system
•	To understand the need for static compensators
•	To develop the different control strategies used for compensation

UNITI	INTRODUCTION TO POWER QUALITY	9

Terms and definitions: Overloading - under voltage - over voltage. Concepts of transients - short duration variations such as interruption – long duration variation such as sustained interruption. Sags and swells – voltage sag – voltage swell – voltage imbalance – voltage fluctuation - power frequency variations. International standards of power quality. Computer Business Equipment Manufacturers Associations (CBEMA) curve.

UNITII	VOLTAGESAGS, INTERRUPTIONS AND OVERVOLTAGES	9

Sources of sags and interruptions- estimating voltage sag performance. Thevenin's equivalent source –analysis and calculation of various faulted condition. Voltage sag due to induction motor starting. Estimation of the sag severity- mitigation of voltage sags, active series compensators. Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding – line arresters - protection of transformers and cables.

UNITIII	HARMONICS	9

Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics- Harmonics Vs transients. Effect of harmonics- harmonic distortion-voltage and current distortion - harmonic indices - inter harmonics – resonance. Harmonic distortion evaluation -devices for controlling harmonic distortion – passive and active filters.

UNITIV	REACTIVE POWER COMPENSATION	9

Reactive power flow control in Power Systems – Control of dynamic power unbalances in Power System – Power flow control – Constraints of maximum transmission line loading – Benefits of FACTS Transmission line compensation – Uncompensated line – Shunt compensation – Series compensation – Phase angle control – Reactive power compensation – Shunt and Series compensation principles – Reactive compensation at transmission and distribution level-Power Factor Correction methods .

UNITV	STATIC SHUNT AND SERIES COMPENSATORS	9

Shunt Compensator: SVC and STATCOM – Operation and control of TSC, TCR and STATCOM – Compensator control – Comparison between SVC and STATCOM.

Series Compensator: TSSC, SSSC -Static voltage and phase angle regulators – TCVR and TCPAR Operation and Control –Applications – Static series compensation – GCSC,TSSC, TCSC and Static synchronous series compensators and their Control – SSR and its damping.

TOTAL:45PERIODS

OUTCOMES:	After successful completion of the course students able to
1.	Classify the power quality issues.
2.	Analyze and mitigate the voltage sag, over voltages and interruptions.
3.	Analyze the harmonic distortion and design the components to reduce harmonics.
4.	Explain about the fundamental principles of Reactive Power Compensation.
5.	Demonstrate various Static shunt and series VAR Compensation Schemes.

TEXTBOOKS:

1.	Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality' McGrawHill,2003.
2.	Edward.F.Fucks and M.A.S.Masoum, "Power Quality in Power System and Electrical Machines," Elsevier Academic Press, 2013.
3.	J.Arrillaga, N.R.Watson, S.Chen, 'Power System Quality Assessment', Wiley, 2011.
4.	K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007.
5.	X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control", Springer Verlag, Berlin, 2006.

REFERENCES:

1.	*G. T.Heydt, "Power Quality", McGraw-Hill Professional, 2007.*
2.	*M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999)*
3.	*G.J.Wakileh,"Power Systems Harmonics–Fundamentals, Analysis and Filter Design," Springer 2007.*
4.	*N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.*
5.	*K.S.Sureshkumar, S.Ashok , "FACTS Controllers & Applications", E-book edition, Nalanda Digital Library, NIT Calicut, 2003.*
6.	*S.Vedam, M.S.Sarma, "Power Quality–VAR Compensation in Power Systems," CRC Press 2013.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE007	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:	
•	To introduce the architecture of PIC microcontroller
•	To educate on use of interrupts and timers To educate on the peripheral devices for data communication and transfer
•	To introduce the functional blocks of ARM processor
•	To educate on the architecture of ARM processors
•	To educate on design applications of ARM processors

UNITI	INTRODUCTION TO PIC MICROCONTROLLER	9
Introduction to PIC Microcontroller – PIC16C6x and PIC16C7x Architecture – PIC16cxx – Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Simple Operations.		
UNITII	**INTERRUPTS AND PERIPHERALS INTERFACING**	**9**
PIC microcontroller Interrupts - External Interrupts - Interrupt Programming – Loop time subroutine – Timers - Timer Programming – Front panel I/O - Soft Keys – State machines and key switches – Display of Constant and Variable strings - I^2C Bus for Peripherals Chip Access – Bus operation - Bus subroutines – Serial EEPROM — Analog to Digital Converter – UART - Baud rate selection – Data handling circuit – Initialization - LCD and keyboard Interfacing - ADC, DAC, and Sensor Interfacing.		
UNITIII	**INTRODUCTION TO ARM PROCESSOR**	**9**
ARM Architecture–ARM programmer's model – ARM Development tools - Memory Hierarchy – ARM Assembly Language Programming – Simple Examples – Architectural Support for Operating systems.		
UNITIV	**ARM ORGANIZATION**	**9**
3-Stage Pipeline ARM Organization – 5-Stage Pipeline ARM Organization –ARM Instruction Execution - ARM Implementation – ARM Instruction Set – ARM co processor interface – Architectural support for High Level Languages – Embedded ARM Applications.		
UNITV	**DESIGN APPLICATIONS**	**9**
Generation of Gate signals for converters and Inverters – Motor Controls – Controlling of DC/ AC appliances –Temperature Control Applications- Monitoring: Overvoltage, Under voltage and Overcurrent- Measurement of frequency – Stand-alone Data Acquisition System applications.		
	TOTAL:45 PERIODS	

OUTCOMES:	After successful completion of the course students able to
1.	Explain the architecture and programming of PIC microcontrollers.
2.	Interface various peripherals to PIC microcontrollers.
3.	Explain architecture, Programming of ARM processor.

4.	Explain organization of ARM processor.
5.	Apply ARM processor to Various applications

TEXTBOOKS:

1.	Peatman,J.B.,"Design with PIC Micro Controllers" PearsonEducation,3rd Edition,2004.
2.	Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication

REFERENCES:

1.	*Rajkamal, "Microcontrollers-Architecture, Programming, Interfacing & System Design", 2nd edition, Pearson, 2012.*
2.	*Mazidi, M.A., "PIC Microcontroller" Rollin Mckinlay, Danny causey Printice Hall of India, 2007.*
3.	*John Pietman Design with microcontrollers McGraw Hill, 1995*
4.	*Microprocessor and Microcomputer based system design by Mohammed Rafiquzzaman.*
5.	*Microcontroller/ Dsp controller reference manual.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE008	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	L	T	P	C
		3	0	0	3

OBJECTIVES:	
•	To understand the concept, planning of DC power transmission and comparison with AC Power transmission.
•	To analyze HVDC converters.
•	To study about the HVDC system control.
•	To analyze harmonics and design of filters.
•	To model and analysis the DC system under study state.

UNITI	INTRODUCTION	9

DC Power transmission technology – Comparison of AC and DC transmission–Application of DC transmission – Description of DC transmission system– Planning for HVDC transmission–Modern trends in HVDC technology– DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.

UNITII	ANALYSIS OF HVDC CONVERTERS	9
Line commutated converter – Analysis of Graetz circuit with and without overlap – Pulse number – Choice of converter configuration – Converter bridge characteristics –Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes.		
UNITIII	**CONVERTER AND HVDC SYSTEM CONTROL**	**9**
Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.		
UNITIV	**REACTIVE POWER AND HARMONICS CONTROL**	**9**
Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM – Generation of harmonics – Design of AC and DC filters – Active filters.		
UNITV	**POWER FLOWANALYSIS IN AC/DC SYSTEMS**	**9**
Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis Case study.		
	TOTAL:45 PERIODS	

OUTCOMES:	After successful completion of the course students able to
1.	Demonstrate the concepts of DC transmission Technology
2.	Apply and Analysis of HVDC Converters
3.	Explain about HVDC system control
4.	Explain about Reactive Power control
5.	Explain about Harmonics control

TEXTBOOKS:

1.	Padiyar, K.R., "HVDC power transmission system", New Age International (P) Ltd., New Delhi, Second Edition,2010.
2.	Edward Wilson Kimbark, "Direct Current Transmission", Vol.I, Wiley interscience, NewYork, London, Sydney, 1971.

REFERENCES:

1.	*KundurP., "Power System Stability and Control", McGraw-Hill, 1993.*
2.	*Colin Adamson and Hingorani NG, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960*

3.	*Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd., New Delhi, 1990.*
4.	*Arrillaga,J., "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983.*
5.	*HVDC transmission by Kamakshaih and V.Kamarraju.,Tata McGraw-Hill 2017.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE009	**TOTAL QUALITY MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To facilitate the understanding of total quality management principles and processes

UNIT I	**INTRODUCTION**	**9**

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

UNIT II	**TQM PRINCIPLES**	**9**

leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT III	**TOOLS OF QUALITY**	**9**

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.		
UNIT IV	**TQM TOOLS AND TECHNIQUES**	**9**
TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.		
UNIT V	**QUALITY SYSTEMS**	**9**
Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation,; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.		
		TOTAL : 45 PERIODS

OUTCOMES	After successful completion of the course, The student will be able to
•	Use the tools and techniques of TQM in manufacturing and service sectors.

TEXT BOOKS

1	Besterfield D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
2	Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.

REFERENCE BOOKS

1	*Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.*
2	*Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.*
3	*James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		1	2			1			1	3	3		2

1-Low, 2-Moderate (Medium), 3-High

18PTEPE010	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:	
•	To study importance of renewable energy systems in distributed generation
•	To analyse and comprehend the various operating modes of solar energy systems and develop maximum power point tracking algorithm
•	To analyse and comprehend the various operating modes of wind electrical generators and develop maximum power point tracking algorithm
•	To impart knowledge on fuel cell systems
•	To Provide knowledge about various hybrid renewable energy systems

UNIT I	INTRODUCTION:	9
Importance of renewable energy, renewable energy systems in distributed power system, Need for Distributed generation, current scenario in Distributed Generation, Planning of DGs.		

UNIT II	PHOTOVOLTAIC SYSTEMS AND ITS GRID INTEGRATION	9
Basics of Photovoltaic, Maximum Power Point Tracking (MPPT) techniques, Sizing of stand-Alone PV systems, Inverters for grid-connected PV system: Line commutated, self-		

commutated with high frequency transformer, central-plant inverter, multiple string inverter, module integrated inverter.		
UNIT III	**WIND POWER SYSTEMS**	**9**
Basics of wind power, Fixed speed and variable speed wind turbines, storm strategies, MPPT techniques Induction generators, synchronous generators, half scale, full scale and PMSG for wind energy systems, Stand-alone systems, and grid connected wind power systems.		
UNIT IV	**FUEL CELL SYSTEMS**	**9**
Introduction to fuel cell systems, types of fuel cell systems, Power Electronic Interface of fuel cell systems, Fuel cell/Battery Hybrid systems.		
UNIT V	**HYBRID RENEWABLE ENERGY SYSTEMS**	**9**
Need for Hybrid Systems- Range and type of Hybrid systems, wind-diesel system, wind-PV system, micro hydro-PV system, biomass-PV-diesel system, PV-Fuel cell hybrid system.		
	TOTAL : 45 PERIODS	

OUTCOMES:	After successful completion of the course students able to
•	Apply Distributed generation in existing power systems.
•	Design PV cell integrated solar power system
•	Design controllers for wind power systems.
•	Apply fuel cells in renewable energy integrated power systems.
•	Design the converter system for hybrid renewable energy sources.

TEXT BOOKS:

1.	Volker Quaschning, James & James, "Understanding Renewable Energy Systems", Earth scan, 2005.
2.	M.GodoySimoes, Felix A. Farret, "Renewable Energy Systems – Design and Analysis with Induction Generators", CRC press, 2nd edition 2007

REFERENCES:

1.	*Mohammed H. Rashid, "Power Electronics Handbook", Elsevier, 2011.*
2.	*Nick Jenkins, Ron Allan, Peter Crossley, David Kirchen and GoranStrbac, "Embedded Generation" IET Power and Energy series, London-2000.*
3.	*M. P. Kazmierkowski, R. Krishnan, J.D. Irwin, "Control in Power Electronics: Selected Problems", Academic Press; 2002.*
4.	*James Larminie and Andrew Dicks, "Fuel Cell Systems Explained", John Wiley & Sons; 2nd edition, 2003.*

5.	*Siegfried Heir, "Grid Integration of Wind Energy Systems", John Willey & Sons; 2nd Edition, 2006.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE011	**PRINCIPLES OF MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

1.	To enable the students to study the evolution of Management.
2.	To study the functions and principles of Planning
3.	To study the functions and principles of Organising
4.	To study the functions and principles of Directing
5.	To study the functions and principles of Controlling

UNIT I	**INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**	**9**

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II	**PLANNING**	**9**

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III	**ORGANISING**	**9**

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV	**DIRECTING**	**9**

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective

communication – communication and IT.		
UNIT V	**CONTROLLING**	**9**
System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.		
		TOTAL : 45 PERIODS

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

1	Explain the evolution of Management.
2	Explain the functions and principles of Planning
3	Explain the functions and principles of Organising
4	Explain the functions and principles of Directing
5	Explain the functions and principles of Controlling

TEXT BOOKS:

1.	Stephen P. Robbins & Mary Coulter, " Management", Prentice Hall (India) Pvt. Ltd., 10th Edition,2009
2.	JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", Pearson Education, 6th Edition, 2004

REFERENCES:

1.	*Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.*
2.	*Robert Kreitner & Mamata Mohapatra, " Management", Biztantra, 2008.*
3.	*Harold Koontz "Essentials of Management" Tata McGraw Hill,1998.*
4.	*Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.*
5.	*Heinz Weihrich "Essentials of Management" Tata McGraw Hill,1998.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE012	POWER SYSTEM DYNAMICS AND CONTROL	L	T	P	C
		2	1	0	3

OBJECTIVES:	
•	To study the problem of power system stability and its impact on the system.
•	To analyse linear dynamical systems and use of numerical integration methods.
•	To Model different power system components for the study of stability
•	To study the methods to improve stability analysis
•	To enhance the system stability

UNIT I	INTRODUCTION TO POWER SYSTEM OPERATIONS, AN ANALYSIS OF LINEAR DYNAMICAL SYSTEM AND NUMERICAL METHODS	9

Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control. Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysis using Numerical Integration Techniques. Issues in Modelling: Slow and Fast Transients, Stiff System

UNIT II	MODELLING OF SYNCHRONOUS MACHINES AND ASSOCIATED CONTROLLERS	12

Modelling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modelling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

UNIT III	MODELLING OF OTHER POWER SYSTEM	10
Modelling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modelling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, WindEnergy Systems		
UNIT IV	**STABILITY ANALYSIS**	**10**
Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multi machine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor droop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools: Transient Stability Programs, Small Signal Analysis Programs.		
UNIT V	**ENHANCING SYSTEM STABILITY**	**4**
Planning Measures. Stabilizing Controllers (Power System Stabilizers). Operational Measures-Preventive Control. Emergency Control.		
	TOTAL : 45 PERIODS	

OUTCOMES:	After successful completion of the course students able to
1.	Explain about power system operations, an analysis of linear dynamical system and numerical methods.
2.	Design of synchronous machines and associated controllers
3.	Design of power system controllers
4.	Illustrate the stability analysis of power system
5.	Design a stabilizing controllers

TEXT BOOKS:

1	K.R. Padiyar, "Power System Dynamics, Stability and Control", B. S. Publications, 2002.
2	P. Kundur, "Power System Stability and Control", McGraw Hill, 1995

REFERENCES:

1.	*P. Sauer and M. A. Pai, "Power System Dynamics and Stability", Prentice Hall, 1997.*
2.	*James A.Momoh, Mohamed. E. EI-Hawary. " Electric Systems, Dynamics and Stability with Artificial Intelligence applications", Marcel Dekker, USA First Edition, 2000.*
3.	*C.A.Gross, "Power System Analysis," Wiley India, 2011.*
4.	*B.M.Weedy, B.J.Lory, N.Jenkins, J.B.Ekanayake and G.Strbac," Electric Power Systems", Wiley India, 2013.*
5.	*K.Umarao, "Computer Techniques and Models in Power System," I.K. International, 2007.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE013	**ELECTRICAL AND HYBRID VEHICLES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To Study the Electric vehicles and their performance
- To study about Electric Trains
- To study the different possible ways of energy storage.
- To study the different strategies related to energy storage systems
- To Study the hybrid vehicles and their performance

UNIT I	**INTRODUCTION**	**9**

Conventional Vehicles: Basics of vehicle performance, vehicle power source Characterization, transmission characteristics, mathematical models to describe vehicle performance.

UNIT II	**ELECTRIC TRAINS**	**9**

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis .Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives,Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT III	**ENERGY STORAGE**	**9**

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: 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 IV	**ENERGY MANAGEMENT STRATEGIES**	**9**
Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management Strategies.		
UNIT V	**HYBRID ELECTRIC VEHICLES**	**9**
Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis		
	TOTAL : 45 PERIODS	

OUTCOMES:	After successful completion of the course students able to
1.	Explain the basic concepts of electric vehicles
2.	Explain the concept of electric traction existing power systems drives
3.	Explain about Energy Storage Requirements in Hybrid and Electric Vehicles
4.	Explain about Energy Management strategies
5.	Explain about hybrid and electric vehicles

TEXT BOOKS:

1	C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011..
2	S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

REFERENCES:

1.	*M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.*
2.	*T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016*
3.	*Iqbal Husain, "Electric and Hybrid Vehicles" ", CRC Press, 2004*
4.	*Chris Mi and M.Abdul Masrur, "Electric and Hybrid Vehicles" by Willey & Sons 2011*
5.	*Amir Khajepour, , "Electric and Hybrid Vehicles" John Wiley & Sons, 2011*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3		2		1						2		2		2
CO2		2			2						2	1		2	3
CO3								2				1	2		1
CO4						2	1			3			3	1	
CO5			2						2			1			2

1-Low, 2-Moderate (Medium), 3-High

18PTEPE014	**COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To introduce the importance of computer aided design method.
- To provide basic electromagnetic field equations and the problem formulation for CAD applications.
- To get familiarized with Finite Element Method as applicable for Electrical Engineering.
- To introduce the organization of a typical CAD package.
- To introduce Finite Element Method for the design of different Electrical apparatus.

UNIT I	**INTRODUCTION**	**9**

Conventional design procedures–Limitations–Need for field analysis based design–Review of Basic principles of energy conversion– Development of Torque/Force.

UNIT II	**MATHEMATICAL FORMULATION OF FIELD PROBLEMS**	9

Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector /Scalar potential–Stored energy in Electric and Magnetic fields–Capacitance-Inductance-Laplace and Poisson's Equations–Energy functional.

UNIT III	**PHILOSOPHY OF FEM**	9

Mathematical models–Differential/Integral equations–Finite Difference method–Finite element method–Energy minimization –Variational method-2D field problems–Discretisation–Shape functions–Stiffness matrix–Solution techniques.

UNIT IV	**CAD PACKAGES**	9

Elements of a CAD System–Pre-processing–Modelling–Meshing–Material properties-Boundary Conditions–Setting up solution–Post processing.

UNIT V	DESIGN APPLICATIONS	9
Voltage Stress in Insulators–Capacitance calculation- Design of Solenoid Actuator –Inductance and force calculation–Torque calculation in Switched Reluctance Motor.		
	TOTAL :45 PERIODS	

OUTCOMES:	After successful completion of the course students able to
1.	Explain the CAD Software
2.	Formulate mathematical problem.
3.	Analyse using finite element method.
4.	Use of the CAD packages.
5.	Design Electrical machine design using CAD packages.

TEXT BOOKS:

1.	S.JSalon, 'Finite Element Analysis of Electrical Machines', Springer, Yes DEE publishers, Indian reprint, 2007
2.	Nicola Bianchi, 'Electrical Machine Analysis using Finite Elements', CRC Taylor & Francis, 2005.

REFERENCES:

1.	*Joao Pedro, A.Bastos and Nelson Sadowski, 'Electromagnetic Modelling by Finite Element Methods', Marcell Dekker Inc., 2003.*
2.	*M Ramamoorthy, " Computer Aided, Analysis and Design of Electrical equipment"*
3.	*P.P.Silvester and Ferrari, 'Finite Elements for Electrical Engineers', Cambridge University Press, 1983.*
4.	*D.A.Lowther and P.PSilvester, 'Computer Aided Design in Magnetics', Springer Verlag, NewYork, 1986.*
5.	*S.R.H.Hoole, 'Computer Aided Analysis and Design of Electromagnetic Devices', Elsevier, NewYork, 1989.*
6.	*George, Omura, "Mastering AutoCAD", BPB Publications, New Delhi, 1988.*
7.	*User Manuals of MAGNET, MAXWELL & ANSYS Softwares.*

COURSE ARTICULATION MATRIX

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

CO5			3		2						1	2			2

1-Low, 2-Moderate (Medium), 3-High

18PTEPE015	POWER SYSTEM TRANSIENTS	L	T	P	C
		2	1	0	3

OBJECTIVES:	
•	To study the importance, causes and effects of transients
•	To study the generation of switching transients and their control using circuit – theoretical concept.
•	To study the mechanism of lighting strokes and the production of lighting surges.
•	To study the propagation, reflection and refraction of travelling waves.
•	To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT I	INTRODUCTION	9

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	9

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. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - ferro resonance.

UNIT III	LIGHTNING TRANSIENTS	9

Review of the theories in the formation of clouds and charge formation-rate of charging of thunder clouds–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 LINES	9

Computation of transients-transient response of systems with series and shunt lumped parameters and distributed lines. 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**	**9**
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.		
	TOTAL:45PERIODS	

OUTCOMES:	After successful completion of the course students able to
1.	Explain the importance of transients
2.	Explain the causes and analyse the switching transients
3.	Explain the lightning transients and protection methods.
4.	Explain the effect of travelling waves on transmission lines.
5.	Explain the effect of transient in integrated power system.

TEXTBOOKS:

1.	Allan Greenwood, 'Electrical Transients in Power Systems', WileyInter Science,NewYork,2nd Edition, 1991.
2.	PritindraChowdhari,"ElectromagnetictransientsinPowerSystem",JohnWileyandSonsInc., SecondEdition,2009
3.	C.S.Indulkar, D.P.Kothari, K.Ramalingam, 'Power System Transients Astatistical approach', PHI Learning Private Limited, Second Edition, 2010
4.	R.D. Begamudre, "Extra High Voltage AC Transmission Engineering", NewAge International.

REFERENCES:

1.	*M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition,2013.*
2.	*R.D.Begamudre, 'Extra High Voltage AC Transmission Engineering', WileyEastern Limited, 1986.*
3.	*Y.Hase, Handbook of Power System Engineering, "Wiley India,2012.*
4.	*J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley, 2012.*
5.	*Allan Greenwood ,Electricel transients in power systems, Wiley India,2012*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE016	SOLID STATE DRIVES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand steady state operation and transient dynamics of a motor load system
- To study and analyze the operation of the converter/chopper fed dc drive, both qualitatively and quantitatively.
- To study and understand the operation and performance of Induction motor drives
- To study and understand the operation and performance of Synchronous motor drives
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drive.

UNIT I	DRIVE CHARACTERISTICS	9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor

UNIT II	CONVERTER / CHOPPER FED DC MOTOR DRIVE	9

Steady state analysis of the single and three phase converter fed separately excited DC motor Drive – continuous and discontinuous conduction– Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive.

UNIT III	INDUCTION MOTOR DRIVES	9

Stator voltage control–energy efficient drive–v/f control–constant airgap flux–field weakening mode– voltage / current fed inverter – closed loop control

UNIT IV	SYNCHRONOUS MOTOR DRIVES	9

V/f control and self control of synchronous motor: Margin angle control and power factor control – permanent magnet synchronous motor.

UNIT V	DESIGN OF CONTROLLERS FOR DRIVES	9

Transfer function for DC motor / load and converter – closed loop control with Current and speed feedback–armature voltage control and field weakening mode – Design of controllers; current controller and speed controller- converter selection and characteristics

TOTAL : 45 PERIODS

OUTCOMES: After successful completion of the course students able to

1. Explain the concepts of Electric drive and its Dynamics
2. Explain the concepts of converter / chopper fed drive.

3.	Explain the concepts of Induction motor drives
4.	Explain the concepts of synchronous motor drives
5.	Design of controllers for Drives
TEXT BOOKS:	
1	Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992.
2	Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002
3	R.Krishnan, Electric Motor & Drives: Modelling, Analysis and Control, Prentice hall of India, 2001.
REFERENCES:	
1.	John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier 2012.
2.	Shaahin Felizadeh, "Electric Machines and Drives", CRC Press(Taylor and Francis Group),2013.
3.	S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 1993
4.	S. Sivanagaraju, M. Balasubba Reddy, A. Mallikarjuna Prasad "Power semiconductor drives" PHI, 5th printing, 2013
5	Vedam Subramanyam, "Thyristor Control of Electric Drives", Tata McGraw Hill, 2007

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE017	**INDUSTRIAL ELECTRICAL SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:		
•	To study importance of electrical system components	
•	To analyse and comprehend the various residential and commercial electrical system	
•	To analyse various illumination systems	
•	To impart knowledge on industrial electrical systems	
•	To impart knowledge on Automation for industrial electrical systems	
UNIT I	**ELECTRICAL SYSTEM COMPONENTS**	**9**
LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices		
UNIT II	**RESIDENTIAL AND COMMERCIAL ELECTRICAL SYSTEMS**	**9**
Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.		
UNIT III	**ILLUMINATION SYSTEMS**	**9**
Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.		
UNIT IV	**INDUSTRIAL ELECTRICAL SYSTEMS**	**9**
HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components		
UNIT V	**INDUSTRIAL ELECTRICAL SYSTEM AND AUTOMATION**	**9**
DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks. Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution		

automation	
	TOTAL : 45 PERIODS
OUTCOMES:	After successful completion of the course students able to
1	Identify various components of industrial electrical systems
2	Illustrate the electrical wiring systems for residential, commercial and industrial Consumers
3	Design Of Illumination Systems
4	Construct the industrial electrical systems
5	Construct the Automation for industrial electrical systems
TEXT BOOKS:	
1	S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
2	K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
REFERENCES:	
1.	*H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.*
2.	*Web site for IS Standards.*
3.	*S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE018	**FIBRE OPTICS AND LASER INSTRUMENTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
OBJECTIVES:					
•	To provide adequate knowledge about holography and Medical applications of				

	Lasers
•	To provide adequate knowledge about Industrial application of lasers
•	To expose the students to the Laser fundamentals
•	To provide adequate knowledge about the Industrial applications of optical fibres.
•	To expose the students to the basic concepts of optical fibres and their properties.

UNIT I	**OPTICAL FIBRES AND THEIR PROPERTIES**	**9**

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, –Principles of light propagation through a fibre: Total internal reflection, Acceptance angle (θa), Numerical aperture and Skew mode, –Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers,– fibre characteristics: Mechanical characteristics and Transmission characteristics, – Absorption losses – Scattering losses – Dispersion – Connectors and splicers –Fibre termination – Optical sources: Light Emitting Diode (LED), – Optical detectors: PIN Diode.

UNIT II	**INDUSTRIAL APPLICATION OF OPTICAL FIBRES**	**9**

Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacement sensor (Extrinsic Sensor) – Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) – Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT III	**LASER FUNDAMENTALS**	**9**

Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Mono chromaticity, Coherence, Divergence and Directionality and Brightness –Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers; – Gas lasers, solid lasers, liquid lasers and semiconductor lasers.

UNIT IV	**INDUSTRIAL APPLICATION OF LASERS**	**9**

Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction And Working, and LIDAR Applications – Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting – Laser trimming of material: Process Of Laser Trimming, Types Of Trim, Construction And Working Advantages – Material Removal and vaporization: Process

Of Material Removal.		
UNIT V	**HOLOGRAM AND MEDICAL APPLICATIONS**	**9**
Holography: Basic Principle, Holography vs. photography, Principle Of Hologram Recording, Condition For Recording A Hologram, Reconstructing and viewing the holographic image– Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.		
	TOTAL : 45 PERIODS	

OUTCOMES:	After successful completion of the course students able to
1	Understand the principle, transmission, dispersion and attenuation characteristics of optical fibers
2	Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications.
3	Understand laser theory and laser generation system.
4	Students will gain ability to apply laser theory for the selection of lasers for a specific Industrial and medical application.

TEXT BOOKS:

1	J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India,1985.
2	J. Wilson and J.F.B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001.
3	Eric Udd, William B., and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists ", John Wiley & Sons, 2011.

REFERENCES:

1.	*G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995.*
2.	*M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.*
3.	*John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.*
4.	*Monte Ross, 'Laser Applications', McGraw Hill, 1968.*
5.	*John and Harry, "Industrial lasers and their application", McGraw-Hill, 2002.*
6.	*Keiser, G., "Optical Fiber Communication", McGraw-Hill, 3rd Edition, 2000.*
7.	*http://nptel.ac.in/courses/117101002/*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High

18PTEPE019	**MICRO ELECTRO MECHANICAL SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:	
•	To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
•	To educate on the rudiments of Micro fabrication techniques.
•	To introduce various sensors and actuators
•	To introduce different materials used for MEMS

•	To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.	
UNIT I	**INTRODUCTION**	**9**
Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection		
UNIT II	**SENSORS AND ACTUATORS-I**	**9**
Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.		
UNIT III	**SENSORS AND ACTUATORS-II**	**9**
Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.		
UNIT IV	**MICROMACHINING**	**9**
Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.		
UNIT V	**POLYMER AND OPTICAL MEMS**	**9**
Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.		
	TOTAL : 45 PERIODS	
OUTCOMES:	After successful completion of the course students able to	
1	Ability to understand the operation of micro devices	
2	Ability to design the micro devices	
3	Ability to understand the concept of Piezo electric effect	
4	Ability to design the micro machine	
5	Ability to understand the Application of micro electro mechanical system	
TEXT BOOKS:		

1	Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2	Stephen D Senturia, 'Microsystem Design', Springer Publication, 200
3	Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002
REFERENCES:	
1.	*Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.*
2.	*Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001.*
3.	*Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.*
4.	*James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.*
5.	*Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application,"Springer, 2010.*

COURSE ARTICULATION MATRIX

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

1-Low, 2-Moderate (Medium), 3-High