GOVERNMENT COLLEGE OF ENGINEERING, BARGUR

Regulation – 2020

AUTONOMOUS

Curriculum for Full Time – B.E. -EEE

From the Academic Year 2020-2021 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 (Full Time)**

CREDIT SUMMARY

S. No	Subject Category/ Semester	1	2	3	4	5	6	7	8	Total Credits	Credits as per AICTE
1.	HS	3			1.5	3		3		10.5	12
2.	BS	8.5	11.5	4	4					28	26
3.	ES	4.5	10.5	5						20	20
4.	PC			12.5	18.5	12	9.5	5		57.5	53
5.	PE					3	6	6	6	21	18
6.	OE					3	3	3	3	12	18
7.	PROJ					1.5	1.5	3	6	12	11
TOTAL										161	158

GOVERNMENT COLLEGE OF ENGINEERING, BARGUR
(AUTONOMOUS)

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATION - 2020
CHOICE BASED CREDIT SYSTEM
CURRICULAM AND SYLLABI FOR I TO VIII SEMESTERS

INDUCTION PROGRAM (Mandatory):

Induction Program	**3- Week Program**	
To be offered at the start of the first semester	• Creative Arts • Universal Human Values • Literary Activities • Yoga / Physical Activities	• Proficiency Modules • Lectures by Eminent People • Familiarization to Department / Branch & Innovations

SEMESTER I

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
THEORY								
1	20ZBS101	Engineering Mathematics- I	BSC	4	3	1	0	4
2	20ZBS102	Engineering Physics	BSC	3	3	0	0	3
3	20EES103	Programming in C	ESC	3	3	0	0	3
4	20ZHS104	Technical English	HSMC	2	2	0	0	2
PRACTICALS								
5	20EES108	Programming in C Laboratory	ESC	3	0	0	3	1.5
6	20ZHS109	Communication English Laboratory	HSMC	2	0	0	2	1
7	20ZBS110	Physics Laboratory	BSC	3	0	0	3	1.5
			TOTAL	20	11	1	8	16

SEMESTER II

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
THEORY								
1	20ZBS201	Engineering Mathematics –II	BSC	4	3	1	0	4
2	20ZBS202	Physics of Semiconductor Devices	BSC	3	3	0	0	3
3	20EBS203	Engineering Chemistry	BSC	3	3	0	0	3
4	20EES204	Engineering Graphics	ESC	5	1	0	4	3
5	20ZMC205	Constitution of India	MC	1	1	0	0	0
6	20EES206	Electric Circuit Analysis	ESC	3	2	1	0	3
PRACTICALS								
7	20EES208	Electric Circuit Laboratory	ESC	3	0	0	3	1.5
8	20ZBS209	Chemistry Laboratory	BSC	3	0	0	3	1.5
9	20ZES210	Workshop Practices	ESC	5	1	0	4	3
			TOTAL	30	14	2	14	22

THIRD SEMESTER

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
THEORY								
1	20ZBS301	Transforms and Partial Differential Equations	BSC	4	3	1	0	4
2	20EES302	Object Oriented Programming	ESC	3	3	0	0	3
3	20EPC303	DC Machines and Transformers	PCC	3	2	1	0	3
4	20EPC304	Analog Electronics	PCC	3	3	0	0	3
5	20EPC305	Electromagnetic Theory	PCC	3	2	1	0	3
6	20ZMC306	Environmental Science and Engineering	MC	1	1	-	-	0
PRACTICAL								
7	20EPC308	Analog Electronics Laboratory	PCC	3	0	0	3	1.5
8	20EPC309	DC Machines and Transformers Laboratory	PCC	4	0	0	4	2
9	20EES310	Object Oriented Programming Laboratory	ESC	4	0	0	4	2
			TOTAL	28	14	3	11	21.5

FOURTH SEMESTER

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
THEORY								
1	20EBS401	Numerical Methods	BSC	4	3	1	0	4
2	20EPC402	Digital Logic Circuits	PCC	3	2	1	0	3
3	20EPC403	Synchronous and Asynchronous Machines	PCC	3	2	1	0	3
4	20EPC404	Linear Integrated Circuits and Applications	PCC	3	3	0	0	3
5	20EPC405	Transmission and Distribution	PCC	3	2	1	0	3
6	20EPC406	Measurements and Instrumentation	PCC	3	3	0	0	3
PRACTICAL								
7	20EPC408	Synchronous and Asynchronous Machines Laboratory	PCC	4	0	0	4	2
8	20EPC409	Linear and Digital Integrated Circuits Laboratory	PCC	3	0	0	3	1.5
9	20EHS410	Soft Skills and Personality Development Laboratory	HSMC	3	0	0	3	1.5
			TOTAL	29	15	4	10	24

FIFTH SEMESTER

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
THEORY								
1	20EPC501	Power System Analysis	PCC	3	2	1	0	3
2	20EPC502	Control Systems	PCC	3	2	1	0	3
3	20EPC503	Microprocessors, Microcontrollers and Applications	PCC	3	2	1	0	3
4	20EHS504	Principles of Management	HSMC	3	3	0	0	3
5		Professional Elective - I	PEC	3	3	0	0	3
6		Open Elective - I	OEC	3	3	0	0	3
PRACTICAL								
7	20EPC508	Control and Instrumentation Laboratory	PCC	3	0	0	3	1.5
8	20EPC509	Microprocessors, Microcontrollers and Applications Laboratory	PCC	3	0	0	3	1.5
9	20EPR510	Project - I	PROJ	3	0	0	3	1.5
			TOTAL	27	15	3	9	22.5

SIXTH SEMESTER

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
THEORY								
1	20EPC601	Power Electronics	PCC	3	3	0	0	3
2	20EPC602	Protection and Switchgear	PCC	3	3	0	0	3
3		Professional Elective - II	PEC	3	3	0	0	3
4		Professional Elective - III	PEC	3	3	0	0	3
5		Open Elective - II	OEC	3	3	0	0	3
PRACTICAL								
6	20EPC608	Power Electronics Laboratory	PCC	4	0	0	4	2
7	20EPC609	Power System Laboratory - I	PCC	3	0	0	3	1.5
8	20EPR610	Project - II	PROJ	3	0	0	3	1.5
			TOTAL	25	15	0	10	20

SEVENTH SEMESTER

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
THEORY								
1	20ZHS701	Professional Ethics	HSMC	3	3	0	0	3
2	20EPC702	Power System Operation and Control	PCC	3	3	0	0	3
3		Professional Elective - IV	PEC	3	3	0	0	3
4		Professional Elective - V	PEC	3	3	0	0	3
5		Open Elective - III	OEC	3	3	0	0	3
PRACTICAL								
6	20EPC708	Power System Laboratory II	PCC	4	0	0	4	2
7	20EPR709	Project - III	PROJ	6	0	0	6	3
			TOTAL	25	15	0	10	20

EIGHTH SEMESTER

SI No	Course Code	Course Name	Course Category	Contact Hours	L	T	P	C
THEORY								
1		Professional Elective - VI	PEC	3	3	0	0	3
2		Professional Elective - VII	PEC	3	3	0	0	3
2		Open Elective - IV	OEC	3	3	0	0	3
PRACTICAL								
3	20EPR808	Project - IV	PROJ	12	0	0	12	6
			TOTAL	18	9	0	12	15

TOTAL NO. OF CREDITS: 161

OPEN ELECTIVE COURSES

(OFFERED TO THE OTHER DEPARTMENTS)

OPEN ELECTIVES								
SI No	**Course Code**	**Course Name**	**Course Category**	**Contact Hours**	**L**	**T**	**P**	**C**
1	20EOE001	MATLAB Programming	OEC	3	2	1	0	3
2	20EOE002	Renewable Energy Sources	OEC	3	3	0	0	3
3	20EOE003	Energy Management and Auditing	OEC	3	3	0	0	3
4	20EOE004	Reliability Engineering	OEC	3	2	1	0	3
5	20EOE005	Disaster Management and Mitigation	OEC	3	3	0	0	3
6	20EOE006	Power Electronics and Drives	OEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSES

SI No	**Course Code**	**Course Name**	**Course Category**	**Contact Hours**	**L**	**T**	**P**	**C**
THEORY								
1.	20EPE001	Applied Soft Computing	PEC	3	3	0	0	3
2.	20EPE002	Wind and Solar Energy Systems	PEC	3	3	0	0	3
3.	20EPE003	Biomedical Instrumentation	PEC	3	3	0	0	3
4.	20EPE004	Fundamentals of Nanoscience	PEC	3	3	0	0	3
5.	20EPE005	High Voltage Engineering	PEC	3	3	0	0	3
6.	20EPE006	Advanced Control Systems	PEC	3	2	1	0	3
7.	20EPE007	Power Quality and FACTS	PEC	3	3	0	0	3
8.	20EPE008	Microcontroller Based System Design	PEC	3	3	0	0	3
9.	20EPE009	High Voltage Direct Current Transmission	PEC	3	3	0	0	3
10.	20EPE010	Electrical Machine Design	PEC	3	2	1	0	3
11.	20EPE011	Power Electronics for	PEC	3	3	0	0	3

		Renewable Energy Systems						
12.	20EPE012	Advanced Electric Drives	PEC	3	3	0	0	3
13.	20EPE013	Power System Dynamics and Control	PEC	3	2	1	0	3
14.	20EPE014	Electrical and Hybrid Vehicles	PEC	3	3	0	0	3
15.	20EPE015	Computer Aided Design of Electrical Apparatus	PEC	3	3	0	0	3
16.	20EPE016	Power System Transients	PEC	3	2	1	0	3
17.	20EPE017	Special Electrical Machines	PEC	3	3	0	0	3
18.	20EPE018	Industrial Electrical Systems	PEC	3	3	0	0	3
19.	20EPE019	Energy Utilization, Conservation and Auditing	PEC	3	3	0	0	3
20.	20EPE020	Solid State Drives	PEC	3	3	0	0	3
21.	20EPE021	Smart Grid	PEC	3	3	0	0	3
22.	20EPE022	Fundamentals of Digital Signal Processing	PEC	3	2	1	0	3
23.	20EPE023	DSP Interfacing	PEC	3	3	0	0	3
24.	20EPE024	FPGA Interfacing	PEC	3	3	0	0	3
25.	20EPE025	Real Time Interfacing and Processing for Power Electronics Application	PEC	3	3	0	0	3

SEMESTER I

20ZBS101	ENGINEERING MATHEMATICS- I	L	T	P	C
	Common to MECH, EEE, ECE & CSE	3	1	0	4

OBJECTIVES: To equip students with the knowledge of

- Matrix algebra and techniques and using them in engineering applications.
- The concept of infinite series and their convergence so that they will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modelling.
- Differential and integral calculus and their applications in various engineering applications.

UNIT I	**MATRICES**	**9+3**

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

UNIT II	**SEQUENCES AND SERIES**	**9+3**

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D'Alembert's ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence.

UNIT III	**APPLICATIONS OF DIFFERENTIAL CALCULUS**	**9+3**

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

UNIT IV	**FUNCTIONS OF SEVERAL VARIABLES**	**9+3**

Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT V	**MULTIPLE INTEGRALS**	**9+3**

Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

TOTAL: (L : 45 + T : 15): 60 PERIODS

OUTCOMES: After completing the course the students will be able to

1.	Solve problems on matrices and to apply concepts of matrix theory whenever applicable in the field of engineering.
2.	Solve problems using convergence tests on sequences and series and to apply them in engineering field appropriately.
3.	Solve problems on differential and integral calculus and will be exposed to their applications in engineering.

TEXTBOOKS:	
1.	Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2.	Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

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.	*Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.*
5.	*Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, PEARSON Publishing, 2011.*

20ZBS102	ENGINEERING PHYSICS	L	T	P	C
	Common to MECH, EEE, ECE & CSE	3	0	0	3

OBJECTIVES:

- To develop knowledge on properties of solids
- To understand the thermal properties of materials and their relevant applications.
- To apply principles of quantum physics in the engineering field
- To know about the fundamentals of LASER
- To know about the fundamental's fibre optics and its applications

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 – 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	THERMAL PHYSICS	9

Transfer of heat energy - thermal expansion of solids and liquids - expansion joints - bimetallic strips - thermal conduction, convection and radiation - heat conductions in solids - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) - thermal insulation

UNIT III	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 – Wave function and its physical Significance – Schrodinger wave equation – Time-dependent and time-independent – Application of Schrodinger wave equation: Particle in a 1 D box.

UNIT IV	LASERS	9

LASER – Interaction of light radiation with materials – Einstein's A and B coefficient derivation – Concept of LASER – Population inversion – Pumping action – Methods for pumping action – Characteristics of LASER – Principle, construction and working of Nd-YAG – Industrial and medical applications of lasers.

UNIT V	FIBRE OPTICS	9

Structure of Optical Fibre – Guiding mechanism – Total internal reflection – Critical Angle – Conditions for total internal reflection – Principle and Propagation of light in Optical Fibres – Numerical aperture and acceptance angle – Types of optical fibres (Material, refractive index and mode) – their characteristics and applications.
TOTAL: 45 PERIODS
OUTCOMES: At the end of the course, the student will be able

•	To explain about three types of elastic moduli and able to calculate them for different materials
•	To apply concepts of thermal properties of materials and their applications in expansion joints and heat exchangers
•	To understand the quantum nature of materials and apply fundamental principles of quantum physics to the engineering field
•	To understand the working principles of lasers and their types
•	To know about fibre optics and mechanism of propagation of light through them

TEXTBOOKS:	
1.	P. Mani, “Engineering Physics I and Engineering Physics II”, Shri Dhanam Publishers, 2016
2.	D.K. Bhattacharya & T. Poonam. “Engineering Physics”. Oxford University Press, 2015.
3.	R.K. Gaur & S.L. Gupta. “Engineering physics”. Dhanpat Rai Publishers, 2012.
4.	A. Marikani, “Engineering Physics”, PHI Learning Pvt., India 2009
5.	B.K. Pandey & S. Chaturvedi. “Engineering Physics”. Cengage Learning India, 2012

REFERENCES:	
1.	*D. Haliday, R. Resnick and J. Walker. “Principles of Physics”. Wiley, 2015*
2.	*M. N. Avadhanulu and P. G. Kshirsagar, “A textbook of engineering physics”, S. Chand and Company Ltd, New Delhi, 2005.*
3.	*K. Rajagopal, “Engineering Physics”, PHI, New Delhi, 2011.*
4.	*R.A. Serway & J.W. Jewett. “Physics for Scientist and Engineers”. Cengage Learning, 2010.*
5.	*M. Arumugam, “Engineering physics”, Anuradha publishers*

20EES103	PROGRAMMING IN C	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn the organization of a digital computer
- Be exposed to the number systems.
- Learn to think logically and write pseudo code or draw flow charts for problems.
- Be exposed to the syntax of C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

UNIT I	INTRODUCTION	8

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm –Pseudo code – Flow Chart.

UNIT II	C PROGRAMMING BASICS	10

Problem formulation – Problem Solving - Introduction to _ C‘ programming –fundamentals – structure of a _C‘ program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in _C‘ – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III	ARRAYS AND STRINGS	9

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV	FUNCTIONS AND POINTERS	9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V	STRUCTURES AND UNION	9

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre processor directives.

	TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Know the various number systems and their conversion.
2.	Write simple programs in C.
3.	Write programs based on arrays.
4.	Write programs using functions and pointers concepts
5.	Write programs using Structures and Files.

TEXT BOOKS:	
1.	Anita Goel and Ajay Mittal, –Computer Fundamentals and Programming in C‖, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2.	Pradip Dey, Manas Ghosh, –Fundamentals of Computing and Programming in C‖, First Edition, Oxford University Press, 2009.
3.	Yashavant P. Kanetkar. –Let Us C‖, BPB Publications, 2011.

REFERENCES:	
1.	*Byron S Gottfried, "Programming with C", Schaum"s Outlines, Second Edition, Tata McGraw-Hill, 2006.*
2.	*Dromey R.G., "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007.*
3	*Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.*

20ZHS104	TECHNICAL ENGLISH	L	T	P	C
ECE & EEE		2	0	0	2

OBJECTIVES:

- To be able to acquire vocabulary by way of reading skills.
- To be able to write iterative as well as recursive programs.
- To be able to represent data in arrays, strings and structures and manipulate them through a program.
- To be able to declare pointers of different types and use them in defining self-referential structures.
- To be able to create, read and write to and from simple text files.

UNIT I	VOCABULARY BUILDING	6

1.1 The concept of Word Formation 1.2 Root words from foreign languages and their use in English 1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. 1.4 Synonyms, antonyms, and standard abbreviations

UNIT II	BASIC WRITING SKILLS	6

2.1 Sentence Structures 2.2 Use of phrases and clauses in sentences 2.3 Importance of proper punctuation 2.4 Creating coherence 2.5 Organizing principles of paragraphs in documents 2.6 Techniques for writing precisely

UNIT III	IDENTIFYING COMMON ERRORS IN WRITING	6

3.1 Subject-verb agreement 3.2 Noun-pronoun agreement 3.3 Misplaced modifiers
3.4 Articles 3.5 Prepositions 3.6 Redundancies 3.7 Clichés

UNIT IV	NATURE AND STYLE OF SENSIBLE WRITING	6

4.1 Describing 4.2 Defining 4.3 Classifying 4.4 Providing examples or evidence
4.5 Writing introduction and conclusion

UNIT V	WRITING PRACTICES	6

5.1 Comprehension 5.2 Précis Writing 5.3 Essay Writing

TOTAL HOURS	30 PERIODS

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

•	Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
•	Participate effectively in formal and informal conversations; introduce themselves and express their opinions in English.
•	Comprehend conversations and deliver short talks in English.
•	Write essays and descriptions of any kind in English.
•	Prepare reports, graph presentation and Technical writing.
TEXT BOOKS:	
1.	On Writing Well. William Zinsser. Harper Resource Book. 2001
2.	Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
3.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
REFERENCES:	
1.	*Richards, C.Jack. Interchange Students' Book-2 New Delhi:CUP,2015.*
2.	*Bailey, Stephen. Academic Writing: A Practical guide for students. New York: Rutledge, 2011.*
3.	*Seely, John. The Oxford guide to writing & Speaking. New York.1998.*
4.	*Bhatia M.P ,A Handbook of APPLIED GRAMMAR ,M.I Publications, AGRA, Sixth Edition*

20EES108	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

•	Be familiar with the use of Office software.
•	Be exposed to presentation and visualization tools.
•	Be familiar with programming in C.
•	Be exposed to Decision making, Looping constructs.
•	Learn to use Arrays, strings, functions.
•	Implement the concepts of structure, Union and file organization.

LIST OF EXPERIMENTS:

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions – Includes Parameter Passing
9. Programs with Pointers.
9. Program using Recursive Function.
10. Program using structures and unions.

TOTAL : 60 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1.	Apply good programming design methods for program development.
2.	Design and implement C programs for simple applications.
3.	Write C programs, which involve decision making and arrays and strings.
4.	Develop programs using functions and pointers.
5.	Develop programs using structures and unions.

20ZHS109	COMMUNICATION ENGLISH LABORATORY	L	T	P	C
ECE & EEE		0	0	2	1

OBJECTIVES:

- To develop their communicative competency in English with specific reference to their speaking and listening.
- To enhance their ability to communicate effectively in interviews.
- To strengthen their prospects of success in competitive examinations.
- To Strengthen a good command over of the language proficiency.
- To comprehend a different types of accent and use them in their communication

UNIT I	**PRONUNCIATION PRACTICE**	**6**

Verbal Ability, Articulation of sounds- Intonation-Stress and Rhythm-Conversation practice-listening Various lectures

UNIT II	**COMMUNICATION AT WORKPLACE**	**6**

Creative writing. Writing job applications - cover letter- resume- e-mails- memos- reports. Writing abstracts- summaries- interpreting visual texts.

UNIT III	**ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS**	**6**

International English Language Testing System (IELTS)- Test of English as a Foreign Language (TOEFL)- Civil Service(Language related part) –English for competitive examinations

UNIT IV	**INTERVIEW SKILLS**	**6**

Different types of Interview format- answering questions- offering information- mock interviews- Body languages.

UNIT V	**SOFT SKILLS**	**6**

Motivation- emotional intelligence-Multiple intelligences- managing changes- time management-leadership straits- team work- career planning- creative and critical thinking

TOTAL HOURS	**30**

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

- Face interviews, group discussions and other language parameters in the job market
- Write any competitive examinations which cover language part in it.
- Take part in any English conversations of any kind in English. Flawlessly without fear and shyness.
- Write articles for newspapers and magazines or any write-up in English without grammar mistakes.
- Come out with leadership qualities, team work and career planning and will also possess critical and creative thinking.

TEXT BOOKS:

1.	Communication Skills for Engineers and Scientists, PHI Learning PVT.LTD, Delhi, 2014.
2.	Communication Skills and Soft Skills An Integrated Approach, Dorling Kindersley (INDIA) PVT.LTD, New Delhi, 2012.
3.	Soft Skills, MJP Publishers, Chennai, 2010.

REFERENCES:

1.	*Craven, Miles. Listening Extra-A resource book of multi-level skills activities. Cambridge University Press, 2004.*
2.	*Seely, John. The Oxford guide to writing & Speaking. New Delhi: Oxford University Press,2020*
3.	*Comfort, Jeremy, et al. Speaking Effectively: Developing speaking skills for Business English. Cambridge University Press, Cambridge: Reprint 2011.*
4.	*Dutt P. Kiranmai and RajeevanGeetha. Basic Communication Skills, Foundation Books:2013*

20ZBS110	PHYSICS LABORATORY	L	T	P	C
Common to MECH, EEE, ECE & CSE		0	0	3	1.5

OBJECTIVES

•	To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids

LIST OF EXPERIMENTS : PHYSICS LABORATORY (ANY 5 EXPERIMENTS)

1.	Determination of rigidity modulus : Torsion Pendulum
2.	Determination of Young's modulus by non-uniform bending method
3.	Determination of Young's modulus by uniform bending method
4.	(a) Determination of wave length and particle size using LASER (b) Determination of acceptance angle in an optical fibre
5.	Determination of thermal conductivity of a bad conductor – Lee's Disc method
6.	Determination of velocity of sound and compressibility of fluid – Ultrasonic interferometer
7.	Determination of wavelength of mercury spectrum – Spectrometer grating
8.	Determination of band gap of a semiconductor
TOTAL	**45 PERIODS**

COURSE OUTCOME: After the course the students will be able to Apply Principles of elasticity, optical and thermal properties for engineering applications.

REFERENCE:

R.Bakkiyaraj and A.Anandakumar, Physics Laboratory Manual, 2020.

SEMESTER II

20ZBS201	ENGINEERING MATHEMATICS- II	L	T	P	C
	Common to MECH, EEE, ECE & CSE	3	1	0	4

OBJECTIVES:	To equip students with the knowledge of
•	Vector calculus and their uses in various field theoretic subjects.
•	Higher order and special type of linear differential equations and methods to find solutions.
•	Laplace transforms and properties and their applications in engineering.
•	Construction of analytic functions and concepts of concepts of conformal mapping, complex integration and series solutions.

UNIT I	**VECTOR CALCULUS**	**9+3**

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green‘s theorem in a plane, Gauss divergence theorem and Stokes‘theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT II	**ORDINARY DIFFERENTIAL EQUATIONS**	**9+3**

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy‘s and Legendre‘s linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT III	**LAPLACE TRANSFORMS**	**9+3**

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

UNIT IV	**ANALYTIC FUNCTIONS**	**9+3**

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z+k$, kz, $1/z$, z^2, e^z and bilinear transformation.

UNIT V	**COMPLEX INTEGRATION**	**9+3**

Complex integration – Statement and applications of Cauchy‘s integral theorem and Cauchy‘s integral formula – Taylor‘s and Laurent‘s series expansions – Singular points – Residues – Cauchy‘s residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

TOTAL: (L : 45 + T : 15): 60 PERIODS	
OUTCOMES: After completing the course the students will be able to	
1.	Solve problems on vector calculus and to apply them in any other field theory related subjects.
2.	Solve differential equations and will be exposed to their applications in various fields of engineering.
3.	Solve problems on Laplace transforms and will be able to use Laplace transform in finding solutions of differential and integral equations and other engineering applications.
4.	Solve complex integration problems and will be exposed to various applications of analytic functions and conformal mapping in engineering.
TEXTBOOKS:	
1.	Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2.	Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.
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.	*Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.*
5.	*Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, PEARSON Publishing, 2011.*

20ZBS202	PHYSICS OF SEMICONDUCTOR DEVICES	L	T	P	C
	COMMON TO CSE, ECE & EEE	3	0	0	3

OBJECTIVES:

- To learn about the fundamentals of electronic materials and their properties
- To understand about bandgap and charge carriers in semiconducting materials
- To learn about transport phenomenon and optical excitation in semiconducting materials
- To know about low dimensional semiconducting materials
- To understand about principle and working of semiconductor devices

UNIT-I	ELECTRONIC MATERIALS	9

Free electron theory, density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, direct and indirect band gaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, occupation probability, Fermi level, effective mass, phonons.

UNIT-II	SEMICONDUCTORS: ENERGY BAND AND CHARGE CARRIERS	9

Energy bands in semiconductors, types of semiconductors, Charge carriers, Intrinsic and extrinsic materials - Carrier concentration: Fermi level, electron and hole concentration equilibrium, Temperature dependence of carrier concentration, compensation and charge neutrality - Conductivity and mobility, effect of temperature, doping and high electric field.

UNIT-III	CARRIER TRANSPORT AND OPTICAL EXCITATION IN SEMICONDUCTOR	9

Carrier transport: Drift transport: Drift current density, mobility effect, and velocity-electric field relations - Diffusion transport: Diffusion of carriers, Einstein relation, Continuity equation, carrier injection, diffusion length.

Optical excitation: Optical absorption, carrier generation, Carrier life time, diffusion length and photo conductivity, Direct and indirect recombination and trapping, Excitons, photoconductive devices.

UNIT- IV	THE P-N JUNCTION DIODE	9

Basic structure of the p-n junction and contact potential, Space charge width, reverse and forward bias, capacitance of p-n junction, Zener and avalanche breakdown in p-n junctions, Zener diode: characteristics and its application (Regulator). Semiconductor heterojunction and metal-semiconductor: Schottky barriers diode, tunnel diode, light emitting diode.

UNIT-V	TRANSISTORS	9

BJT: Structure, basic principle of operation, input and output characteristics of CE, CB and CC configuration – FET: JFET- Principle of operation, pinch off and saturation, gate control, I-V characteristics – MOSFET- Structure, principle of operation, input and output characteristics of CS, CD and CG configuration – SCR: Structure, principle of operation and its characteristics.	
	TOTAL: 45 PERIODS

COURSE OUTCOMES

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

1.	To understand fundamentals of electronic materials and their properties.
2.	To explain about the origin of band gap in semiconductors.
3.	To describe about charge transport and optical excitation phenomenon.
4.	To understand about p-n junction semiconductor diodes
5.	To understand about the principal and working of semiconductor transistors

TEXT BOOKS:

1.	*P.Mani, "Physics for Electronics Engineering", Shri Dhanam Publishers, 2020.*
2.	*S. Murugavel, G. Senthil Kumar, "Physics for Electronics Engineering", VRB publishers, 2020*
3.	*A. Marikani, "Engineering Physics", PHI Learning Pvt., India, 2009.*
4.	*S. Mani Naidu, "Applied Physics", Pearson Publisher, India, 2010.*

REFERENCES:

1.	*M. Balkanski and R.F. Wallis, "Semiconductor Physics and Applications", Oxford University Press, First Published 2000.*
2.	*Donald A. Neamen, "Semiconductor Physics and Devices: Basic Principles", McGraw-Hill Higher Education, Third Edition, 2003.*
3.	*S.M. Sze and Kwok K. Ng, "Physics of Semiconductor Devices", Wiley-Interscience, Third Edition, 2007.*
4.	*V.K. Mehta and Rohit Mehta, "Principles of Electronics", Chand & Co, 2014.*

20ZBS203	ENGINEERING CHEMISTRY	L	T	P	C
	(COMMON FOR ECE / EEE / CSE)	3	1	0	4

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	9+3

Characteristics – alkalinity and its significance – hardness (problems) - 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 (Scales & Sludge, Boiler corrosion, Priming & Foaming, Caustic embrittlement) – water treatment – Internal treatment – external treatment – zeolite method - Demineraliztion process – desalination – reverse osmosis.

UNIT II	ELECTROCHEMISTRY AND CORROSION	9+3

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 and its mechanism - 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 – metallic coatings – electroplating (Cu) and electro less plating (Ni).

UNIT III	POLYMERS AND COMPOSITES	9+3

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 – **Biopolymers – Properties and its applications (Polylactic acid) – Conducting polymers - Properties and its applications (Polyacetylene)**
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	9+3

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	ANALYTICAL TECHNIQUES AND NANOMATERIALS	9+3

Spectroscopy: Electromagnetic spectrum - Fundamentals of spectroscopy – Instrumentation, working principle and applications of UV-Visible spectrophotometer, Atomic Absorbance Spectrophotometer, Flame photometer.

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

TOTAL (L= 45 ; T=15) : 60 PERIODS

COURSE OUTCOMES

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

•	Apply the knowledge of basic science in identifying, to formulate and to solve the engineering problems.
•	Analyze water borne problems faced in boilers, need for water treatment and various methods and techniques for treating hard water.
•	Understand polymerization reactions and electrochemical reactions and its applications.
•	Acquire Knowledge about energy conversion and chemical reaction taking place in nuclear, solar, wind energy, Batteries, fuel cells and its applications..
•	Obtain in-depth knowledge on various nanomaterials and its applications in electronic devices. Students get basic knowledge on advanced analytical techniques.

TEXT BOOKS:

1.	*Vairam S, Kalyani P and Suba Ramesh.,"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.*
5.	*Sivasankar B, "Engineering Chemistry", Tata Mc Graw-Hill Publishing Company Ltd, New Delhi , 2008.*

20EES204	ENGINEERING GRAPHICS	L	T	P	C
		1	0	4	3

COURSE OBJECTIVES:

•	This course aims to introduce the concept of graphic communication, develop the drawing skills for communicating concepts, ideas and designs of engineering products and to expose them to existing national standards related to technical drawings
•	To draw the projection of simple solids like prisms, pyramids, cylinder etc.
•	To draw the development of surfaces to estimate the sheet metal requirement and to prepare sectional views of solids.
•	To develop skills in three-dimensional visualization of engineering components and to draw isometric views of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications – use of drafting instruments – BIS / ISO conventions and specifications – size, layout and folding of drawing sheets – lettering and dimensioning.

UNIT I	PLANE CURVES AND FREE-HAND SKETCHING	15

Basic geometrical constructions, curves used in engineering. Conics – construction of ellipse, parabola and hyperbola by eccentricity method – drawing of tangents and normal to the above curves. Visualization concepts and free hand sketching: visualization principles –representation of three dimensional objects – layout of views- freehand sketching of multiple views from pictorial views of objects.

UNIT II	PROJECTION OF POINTS, LINES AND PLANE SURFACES	15

Orthographic projection – Principles-principal planes - First angle projection - Projection of points - Projection of straight lines inclined to both the principal planes - determination of true lengths and true inclinations by rotating line method - traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III	PROJECTION OF SOLIDS	15

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids, when the axis is inclined to both the principal planes by rotating object method.

UNIT IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	15

Sectioning of prisms, pyramids, cylinders and cones in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – prisms, pyramids cylinders and cones.

UNIT V	ISOMETRIC PROJECTION AND OVERVIEW OF COMPUTER GRAPHICS	15

Principles of isometric projection – isometric scale –isometric projections of simple solids and truncated solids - prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions – Introduction to CAD - The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD- (CAD – evaluation during CA only)	
Lecture: 15 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 75 Periods	
OUTCOMES:	On completion of this course, students will be able to
1	Familiarize with the fundamentals, standards of Engineering graphics and Perform freehand sketching of multiple views of basic geometrical constructions.
2	Draw orthographic projections of points, lines and plane surfaces.
3	Draw projections of simple solids.
4	Visualize and draw sectioned solids and development of surfaces.
5	Visualize and draw isometric views of simple solids and appreciate the use of computers in drawing and modelling of simple objects.
TEXT BOOKS:	
1	Natrajan K. V., "**A text book of Engineering Graphics**", Dhanalakshmi Publishers, Chennai, 2016.
2	Venugopal K. and Prabhu Raja V., "**Engineering Graphics**", New Age International (P) Limited, 2016.
3	Shah, M. B. and Rana B. C. **"Engineering Drawing and Computer Graphics",** Pearson Education, 2010
REFERENCES:	
1	*N S Parthasarathy and Vela Murali, "**Engineering Graphics**", Oxford University, Press, New Delhi, 2015.*
2	*Gopalakrishna K.R., **"Engineering Drawing" (Vol. I&II combined),** Subhas publications, Bangalore, 2014.*
3	*Basant Agrawal and Agrawal C.M., "**Engineering Drawing**", Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.*
4	*Luzzader, Warren J. and Duff John M., "**Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production**", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005*
5	*Bhatt N. D. and Panchal V. M., **"Engineering Drawing**", Charotar Publishing House, 53rd Edition, 2014.*

MAPPING OF COs, POs AND PSOs:															
	POs												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2		3		3			3			3	2	2
CO2	3	2	2		3		3			3			3	2	2
CO3	3	2	2		3		3			3			3	2	2
CO4	3	2	2		3		3			3			3	2	2
CO5	3	2	2		3		3			3			3	2	2
Average	3	2	2		3		3			3			3	2	2
Round off	3	2	2		3		3			3			3	2	2
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

20ZMC205	CONSTITUTION OF INDIA	L	T	P	C
	(Common to all Branches)	1	0	0	0

OBJECTIVES:

- To provide understanding of basic concepts of Indian Constitution and various organs created by the constitution including their functions.

UNIT I	INTRODUCTION	5

Constitution – Definition and Classification - Constitutional Organs - Indian Constitution: Sources and constitutional history, Salient features of Indian Constitution - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy Rule of Law - Separation of powers Constitution - Doctrine of Basic Structure.

UNIT II	UNION GOVERNMENT & STATE GOVERNMENT AND THEIR ADMINISTRATION	5

Distribution of Powers between Center and States Structure of the Indian Union: Federalism, Centre- State -relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

UNIT III	LOCAL ADMINISTRATION AND ELECTION COMMISSION	5

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy Emergency Provisions - Amendment of Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

TOTAL : 15 PERIODS

COURSE OUTCOMES	On completion of this course, students will be able to
1.	Understand the basic concepts of Indian Constitution and various organs created by the constitution including their functions.

TEXT BOOKS:

1.	V.N. Shukla, **"Constitution of India",** EBC, 13th Edition, 2017.
2.	M.P. Jain, **"Indian Constitutional Law",** LexisNexis, 8th Edition, 2018.
3	H.M.Seervai, "**Constitution of India**", LexisNexis, Second edition, 2014.

REFERENCES:

1	*DD Basu's, **"Shorter Constitution of India",** Lexisnexis, 14 th Edition, 2016*
2	*https://www.india.gov.in/my-government/constitution-india/constitution-india-full-text*

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			1		1	3			1	2	1	2		2	1
Average			1		1	3			1	2	1	2		2	1

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

20EES206	ELECTRIC CIRCUIT ANALYSIS	L	T	P
		2	1	0

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 study Phasor diagrams and analysis of two port network

UNIT I	DC and AC CIRCUITS	9

Node and Mesh Analysis. Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Concept of duality and dual networks.

UNIT II	THREE PHASE CIRCUIT ANALYSIS	9

Representation of sine function as phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

UNIT III	TRANSIENT ANALYSIS OF ELECTRIC CIRCUITS	9

Solution of first and second order differential equations for Series and parallel R-L, R-C, RLC circuits, initial and final conditions in network elements, forced and free response, time Constants, steady state and transient state response.

UNIT IV	ELECTRICAL CIRCUIT ANALYSIS USING LAPLACE TRANSFORMS	9

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances.

UNIT V	TWO PORT NETWORK AND NETWORK FUNCTIONS	9

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

TOTAL : 45 PERIODS

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

1.	Apply network theorems for the analysis of electrical circuits.
2.	Analyze the circuits of single-phase and three-phase circuits using sinusoidal input.
3.	Obtain the transient and steady-state response of electrical circuits.
4.	Obtain the solution of electric circuit using Laplace transform.
5.	Analyze the two port networks and network functions to get network parameters solutions.

TEXT BOOKS:

1.	M. E. Van Valkenburg, –Network Analysis‖, Prentice Hall, 2006.
2.	D. Roy Choudhury, –Networks and Systems‖, New Age International Publications, 1998.

3.	Sudhakar and ShyamMohan.Sp,–Circuits and Networks Analysis and Synthesis, Tata Mc Graw hill, 2015.
REFERENCES:	
1.	*W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.*
2.	*C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.*
3.	*K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.*

20EES208	ELECTRIC CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To solve DC and AC electric circuits using mesh analysis, nodal analysis, and network theorems.
- To conduct experiment on DC and AC electric circuits to know the time and frequency response
- To Design and simulate resonance circuits, filter circuits, and three phase circuits
- To fabricate electrical and electronics circuits.

LIST OF EXPERIMENTS

1. Experimental verification of Kirchhoffs voltage and current laws
2. Experimental verification of network theorems (Thevenins, Norton, Super position and Maximum Power Transfer Theorem).
3. Experimental determination of time constant of series R-C circuits.
4. Experimental determination of frequency response of RLC circuits.
5. Design and Simulation of series resonance circuit.
6. Design and Simulation of parallel resonant circuits.
7. Simulation of low pass and high pass passive filters.
8. Simulation of three phases balanced and unbalanced star, delta networks circuits.
9. Experimental determination of power in three phase circuits by two-wattmeter method.
10. Determination of two port network parameters.
11. Transient analysis of second order under damped system.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Regulated Power Supply:0–15VD.C-10 Nos/Distributed Power Source.
2. Function Generator (1MHz) - 10Nos.
3. Oscilloscope (20MHz) - 10Nos.
4. Digital Storage Oscilloscope (20MHz) –1 No.

5. Circuit Simulation Software(5Users) (Pspice/Matlab/other Equivalent software Package) with PC (5Nos.) and Printer (1 No.)

6. AC/DC- Voltmeters(10Nos.),Ammeters(10Nos.) and Multi-meters(10Nos.)

7. Single Phase Wattmeter–3 Nos.

8. Double- element wattmeter - 2 Nos

9. Decade Resistance Box, Decade Inductance Box, Decade CapacitanceBoxEach-6Nos.

10. Circuit Connection Boards- 10Nos.

12.PSpice or its equivalent software - 10 users

	TOTAL:60 PERIODS

OUTCOMES:	After successful completion of the course students able to
1.	Solve DC and AC electric circuits using mesh analysis, nodal analysis, and network theorems.
2.	Analyse the time and frequency response of DC and AC electric circuits.
3.	Design and simulate resonance circuits, filter circuits, and three phase circuits
4.	Fabricate electrical and electronics circuits.
5.	Analyse transients in electrical circuits.

20ZBS209	CHEMISTRY LABORATORY	L	T	P	C
	(ECE/EEE/CSE/MECH)	0	0	3	1.5

OBJECTIVES:

- To make students conversant with hands on water parameter analysis.
- To make the student to acquire practical skills in the corrosion in metals.
- To acquaint the students with the determination of molecular weight of a polymer by Ostwald viscometer.
- To make the student acquire practical skills in analytical instruments.
- To make students conversant with hands on heavy metal analysis.

1. Determination of total hardness of given water sample by EDTA method.
2. Determination of alkalinity in given water sample.
3. Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
4. Conductometric titration using mixture of acids and strong base.
5. Determination of strength of in given hydrochloric acid using pH meter.
6. Estimation of sodium present in water using flame photometer.
7. Estimation of Zn present in effluent using Atomic Absorption Spectroscopy(AAS)
8. Corrosion experiment – weight loss method
9. Estimation of iron content of the given solution using potentiometer meter.
10. Estimation of iron content of the given sample using Spectro photometer (thiocyanate method).

COURSE OUTCOMES

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

a.	The students will be outfitted with hands-on knowledge in the qualitative and quantitative chemical analysis of water quality related parameters, corrosion studies, heavy metal analysis, etc.

REFERENCES:

1.	Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore 1994.
2.	Jeffery G.H., Bassett J., Mendham J.and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
3.	Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.
4.	Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York 2001.
5.	D.P. Shoemaker and C.W.Garland, Experiments in Physical Chemistry, McGraw Hill, London.

20ZES210	WORKSHOP PRACTICES	L	T	P	C
Common to MECH, EEE, ECE and CSE Branches		1	0	4	3

COURSE OBJECTIVES:

- To make various basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail joint, Mortise & Tenon joint and Cross-Lap joint
- To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint.

LIST OF EXPERIMENTS:

1. Introduction to use of tools and equipment in Carpentry, Welding, Foundry and Sheet metal
2. Safety aspects in Welding, Carpentry and Foundry
3. Half lap Joint and Dovetail Joint in Carpentry
4. Welding of Lap joint, Butt joint and T-joint
5. Preparation of Sand mold for cube, conical bush, pipes and V pulley
6. Fabrication of parts like tray, frustum of cone and square box in sheet metal
7. Electrical wiring – simple house wiring
8. Plumbing
9. CNC Machines demonstration and lecture on working principle.
10. Additive manufacturing demonstration and lecture on working principle.

Lecture: 15 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 75 Periods

COURSE OUTCOMES:	On completion of this course, students will be able to
CO1.	Use tools and equipment used in Carpentry, Welding, Foundry and Sheet metal.
CO2.	Make half lap joint dovetail joint in carpentry and welded lap joint, butt joint and T-joint
CO3.	Prepare sand mould for cube, conical bush, pipes and V pulley.
CO4.	Fabricate parts like tray, frustum of cone and square box in sheet metal
CO5.	Carry out minor works/repair related to electrical wiring and plumbing.

MAPPING OF COs, POs AND PSOs:

	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2		3					3			3	2	1
CO2	3	2	2		3					3			3	2	1
CO3	3	2	2		3					3			3	2	1
CO4	3	2	2		3					3			3	2	1
CO5	3	2	2		3					3			3	2	1
Average	3	2	2		3					3			3	2	1
Round off	3	2	2		3					3			3	2	1

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

SEMESTER III

20ZBS301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order partial differential equations - Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES **9+3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV FOURIER TRANSFORMS **9+3**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS **9+3**

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL : (L : 45 + T : 15): 60 PERIODS

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

1. The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

TEXT BOOKS:

1.	Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 2016.
2.	Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi, 2017.
3.	Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt Ltd., 1998.
REFERENCES:	
1.	Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", Laxmi Publications Pvt Ltd, 9th Edition 2016.
2.	Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.
3.	Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2016.
4.	Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.
5.	Ray Wylie C and Barrett .L.C, "Advanced Engineering Mathematics", 6th Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi, 2012.
6.	Datta K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, 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		3			2	2

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

20EES302	OBJECT ORIENTED PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads and generics classes
- To design and build simple Graphical User Interfaces

UNIT I	INTRODUCTION TO OOP AND JAVA FUNDAMENTALS	9

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java – The Java Environment - Java Source File -Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java– constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays , Packages – Java Doc comments.

UNIT II	INHERITANCE AND INTERFACES	9

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Object cloning -inner classes, Array Lists – Strings.

UNIT III	EXCEPTION HANDLING AND I/O	9

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.

UNIT IV	MULTITHREADING AND GENERIC PROGRAMMING	9

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations.

UNIT V	EVENT DRIVEN PROGRAMMING	9

Graphics programming - Frame – Components - working with 2D shapes - Using color, fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events AWT event hierarchy - Introduction to Swing – layout management - Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows–Menus – Dialog Boxes.

TOTAL : 45 PERIODS

OUTCOMES:	Upon completion of the course, students will be able to:
2.	Develop Java programs using OOP principles
3.	Develop Java programs with the concepts inheritance and interfaces
4.	Build Java applications using exceptions and I/O streams
5.	Develop Java applications with threads and generics classes
6.	Develop interactive Java programs using swings
TEXT BOOKS:	
1.	Herbert Schildt, "Java The complete reference", 8 Edition, McGraw Hill Education, 2011.
2.	Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9 Edition, Prentice Hall, 2013.
REFERENCES:	
1.	*Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3*
2.	*Steven Holzner, "Java 2 Black book", Dreamtech press, 2011*
3.	*Timothy Budd, "Understanding Object-oriented programming with Java", Updated Edition,Pearson Education, 2000.*

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

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

20EPC303	DC MACHINES AND TRANSFORMERS	L	T	P	C
		2	1	0	3

OBJECTIVES:

- 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

20EPC304	ANALOG ELECTRONICS	L	T	P	C
		3	0	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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
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

20ZMC306	ENVIRONMENTAL SCIENCE AND ENGINEEERING	L	T	P	C
	(Common to ECE/EEE/CSE/MECH)	1	-	-	0

OBJECTIVES:

- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I	ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY (CO-a &b)	7

concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers- types of ecosystem (forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) - energy flow in the ecosystem – ecological succession processes –types – 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 – 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 (CO-a &c)	3

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards– solid waste management: causes, effects and control measures.

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

UNIT III	NATURAL RESOURCES (CO-a &d)	5

Forest resources: Use and over-exploitation, deforestation – Water resources: Use and overutilization of surface and ground water– Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems– Energy resources: renewable and non renewable energy sources, use of alternate energy sources.– Land

resources- land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources.

Field study of local area to document environmental assets – river / forest / grassland / hill

TOTAL : 15 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.

1.	Ability to apply the knowledge of environmental science in identifying, to formulate and to solve the environmental problems.
2.	Public awareness of environmental function is at infant stage.
3.	Ignorance and incomplete knowledge has led to misconceptions.
4.	Development and improvement in std. of living has led to serious environmental disasters.

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	*Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.*
2	*Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press 2005.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1		2			2							2	2		2
CO2		3			2			2							2
CO3					2					2		2		2	
CO4		2			3			2					2	3	

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

20EPC305	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	PSO
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

20EPC308	ANALOG ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To obtain accurately the characteristics of electronic devices (Diodes, BJT, and MOSFET), oscillators and voltage regulators independently.
- To construct accurately wave shaping circuits for the given specifications independently.
- To obtain accurately the frequency response of various amplifiers with different configurations based on BJT and FET independently.

LIST OF EXPERIMENTS:

1. Characteristics of PN diode and Zener diode.
2. Diode Clippers and Clampers.
3. Single phase half wave and full wave rectifiers.
4. Characteristics of Voltage Regulators.
5. Characteristics of Transistor under CE, CC and CB configurations.
6. Characteristics of FET.
7. Characteristics of MOSFET.
8. Characteristics of UJT.
9. Frequency response of Common Emitter Amplifier.
10. Frequency response of Common Collector Amplifier.
11. Frequency response of Common Source FET Amplifier.
12.Design of RC Phase Shift and Wien bridge Oscillators.

TOTAL : 45 PERIODS

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

1.	Obtain accurately the characteristics of electronic devices (Diodes, BJT, and MOSFET), oscillators and voltage regulators independently.
2.	Construct accurately wave shaping circuits for the given specifications independently.
3.	Obtain accurately the frequency response of various amplifiers with different configurations based on BJT and FET independently.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2					2				2			2		2
CO2		2	2												2
CO3	2									2					2

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

20EPC309	DC MACHINES AND TRANSFORMERS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To draw the characteristics of DC Generators and Motors and determine the losses and efficiency.
- To draw the equivalent circuit and characteristics of transformers and determine the losses and efficiency.

LISTOFEXPERIMENTS:

1. Study of starters: 2-point, 3-point and 4-point starters.
2. Open circuit and load characteristics of DC shunt generator.
3. LoadcharacteristicsofDCcompoundgenerator with differential and cumulative connections
4. Load Test on DC series generator.
5. Load test on DC shunt and compound motor.
6. Load test on DC series motor.
7. Swinburne'stest and speed control of DC shunt motor.
8. Hopkinson's test on DC motor –generator set.
9. Load test on single-phase transformer and three phase transformers.
10. Open circuit and short circuit test on single phase transformer.
11. Sumpner's test on single phase transformers.
12. Separation of no-load losses in single phase transformer.
13. Scott connection and 3-phasetransformersconnections.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

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

TOTAL : 60 PERIODS

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

1.	Able to draw the characteristics of DC Generators and Motors and determine the losses and efficiency.
2.	Able to draw the equivalent circuit and characteristics of transformers and determine the losses and efficiency.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	2				2				2			1		2
CO2	2	2				2						2	2		2

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

20EES310	OBJECT ORIENTED PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, arraylist, exception
  To develop applications using generic programming and event handling.

LISTOFEXPERIMENTS:

1. Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection(
   - First 100 units - Rs. 1 per unit
   - 101-200 units - Rs. 2.50 per unit
   - 201 -500 units - Rs. 4 per unit
   - > 501 units - Rs. 6 per unit

   If the type of the EB connection is commercial, calculate the amount to be paid as follows:
   - First 100 units - Rs. 2 per unit
   - 101-200 units - Rs. 4.50 per unit
   - 201 -500 units - Rs. 6 per unit
   - 501 units - Rs. 7 per unit
2. Develop a java application to implement currency converter
   INR and vice versa) converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa) , time converter (hours to minutes, seconds and vice versa) using packages.
3. Develop a java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay
   inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
4. Design a Java interface for ADT Stack. Implement this interface using array. Provide necessary exception handling in both the implementations.
5. Write a program to perform string operations using ArrayList. Write functions for the following
   a. Append - add at end
   b. Insert – add at particular index
   c. Search
   d. List all string starts with given letter
6. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.
7. Write a Java program to implement user defined exception handling.

8. Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes. 9. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number. 10. Write a java program to find the maximum value from the given type of elements using a generic function. 11. Design a calculator using event-driven programming paradigm of Java with the following options. a) Decimal manipulations b) Scientific manipulations 12. Develop a mini project for any application using Java concept
TOTAL : 60 PERIODS

OUTCOMES:	Upon completion of the course, the students will be able to
1.	Develop and implement Java programs for simple applications that make use of classes, packages and interfaces.
2.	Develop and implement Java programs with arraylist, exception handling and multithreading
3.	Design applications using file processing, generic programming and event handling.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS3
CO1	1									2			2		
CO2	2									2			2		
CO3		2	2					2						2	

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

Semester-IV

20EBS401	NUMERICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	12

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT II	INTERPOLATION AND APPROXIMATION	12

Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines – Difference operators and relations – Interpolation with equal intervals – Newton's forward and backward difference formula.

UNIT III	NUMERICAL DIFFERENTIATION AND INTEGRATION	12

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method – Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV	INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS	12

Single step methods – Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge – Kutta method for solving first order equations – Multi step methods – Milne's and Adams – Bash forth predictor corrector methods for solving first order equations.

UNIT V	BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS	12

Finite difference methods for solving second order two point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL :60 PERIODS

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

1	Understand the basic concepts and techniques of solving algebraic and transcendental equations.
2	Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
3	Apply the numerical techniques of differentiation and integration for engineering problems.
4	Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
5	Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXTBOOKS :

1	Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2	Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCES :

1.	*Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.*
2.	*Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.*
3.	*Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.*
4.	*Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.*
5.	*Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.*
6.	*Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.*
7.	*Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.*

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

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

20EPC402	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

20EPC403	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

20EPC404	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, "Micro electronic 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

20EPC405	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

20EPC406	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

20EPC408	SYNCHRONOUS AND ASYNCHRONOUS MACHINES LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To expose the students to the operation and characteristics of induction machines
- To expose the students to the operation and characteristics of synchronous machines
- To expose the students to the operation of AC starters

LIST OF EXPERIMENTS

1. Load test on three-phase induction motor.
2. No load and blocked rotor tests on three-phase induction motor (Determination of equivalent circuit parameters).
3. Separation of No-load losses of three-phase induction motor.
4. Regulation of three phase alternator by EMF and MMF methods.
5. Regulation of three phase alternator by ZPF and ASA methods.
6. Regulation of three phase salient pole alternator by slip test.
7. Measurements of negative sequence and zero sequence impedance of alternators.
8. V and Inverted V curves of Three Phase Synchronous Motor.
9. Load test on single-phase induction motor.
10. No load and blocked rotor test on single-phase induction motor.
11. Study of Induction motor Starters.

TOTAL :60 PERIODS

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

1.	Operate the induction machine for various applications
2.	Operate the synchronous machine for various applications
3.	Apply the starters for AC induction machines

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Synchronous Induction motor 3HP – 1 No.
2. DC Shunt Motor Coupled With Three phase Alternator – 4 nos
3. DC Shunt Motor Coupled With Three phase Slip ring Induction motor – 1 No.
4. Three Phase Induction Motor with Loading Arrangement – 2 nos
5. Single Phase Induction Motor with Loading Arrangement – 2 nos
6. Tachometer -Digital/Analog – 8 nos
7. Single Phase Auto Transformer – 2 nos
8. Three Phase Auto Transformer – 3 nos
9. Single Phase Resistive Loading Bank – 2 nos
10. Three Phase Resistive Loading Bank – 2 nos
11. Capacitor Bank – 1 No.

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			3					2			2			2	
CO3	2							2					2		2

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

20EPC409	LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To design testing and characterizing of circuit behaviour with analog ICs.
- To design testing and characterizing of circuit behaviour with Digital ICs.
- To know the applications of Operational Amplifier
- To know the applications of Digital ICs

LIST OF EXPERIMENTS

1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa
3. Parity generator and parity checking.
4. Encoders and Decoders.
5. Counters: Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
7. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.
8. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator Differentiator and Differential Amplifier.
9. Voltage to frequency characteristics of NE/ SE 566 IC
10. Variability Voltage Regulator using IC LM317.

TOTAL :45 PERIODS

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

1	Understand and implement Boolean Functions.
2	Understand the importance of code conversion.
3	Design and implement 4-bit shift registers
4	Acquire knowledge on Application of Op-Amp

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS: (3 per Batch)

1. Dual ,(0-30V) variability Power Supply – 10 Nos
2. CRO – 30MHz – 9 Nos
3. Digital Multimeter – 10 Nos
4. Function Generator – 1 MHz – 8 Nos
5. IC Tester (Analog) – 2 Nos
6. Bread board – 10 Nos

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
CO2	2											2			3

CO3		2	3					2						2	
CO4	2									2		2	2	2	

1-Low, 2-Moderate (Medium), 3-High2

20EHS410	SOFT SKILLS AND PERSONALITY DEVELOPMENT LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES

●	To help the students to improve the listening, speaking, reading and writing skills.
●	To make them prepare for national and international examinations and placements.
●	To help them to face the interviews and to improve soft skills.

UNIT I	LISTENING AND SPEAKING SKILLS	9

Conversational skills (formal and informal)-making effective presentations using computers, listening/watching debates, documentaries. Listening to lectures, discussions from TV/ Radio/ Podcast.

UNIT II	READING AND WRITING SKILLS	9

Reading different genres of tests ranging from newspapers to creative writing. Writing different types of Applications and complaints- Writing reviews – film appreciation- thesis writing –posture making- advertisement-magazine preparation.

UNIT III	ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS	9

International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) - Civil Service (Language related)- Verbal Ability.

UNIT IV	SOFTSKILLS	9

Motivation- emotional intelligence-Multiple intelligences- - career planning -creative and critical thinking.

UNIT V	EMPLOYABILITY AND CORPORATE SKILLS	9

Interview skills – Types of interview, preparation for interview, mock interview. Group Discussion leadership and co-ordination. Time management and effective planning- Stress management – causes and effect-stress relief techniques

TOTAL	45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1	Make presentations and participate in group discussions.
2	Take international examinations such as IELTS and TOEFL.
3	Successfully answer questions in interviews.
4	Create postures, advertisements and magazine making which are the parts of writing skills.

	5	Write film – appreciation, book review and Thesis writing which are the part of analytical thinking and creative writing

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

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

Semester-V

20EPC501	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

20EPC502	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

20EPC503	MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS	L	T	P	C
		2	1	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

20EHS504	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to study the evolution of Management.
- To study the functions and principles of Planning
- To study the functions and principles of Organising
- To study the functions and principles of Directing
- 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 & Heinz Weihrich "Essentials of Management" Tata McGraw Hill,1998.*
4.	*Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.*

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

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

20EPC508	CONTROL AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTVES:

- 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

20EPC509	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

20EPR510	PROJECT I	L	T	P	C
		0	0	3	1.5

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 early in the Fifth semester and carry out both design and fabrication of an Electrical and Electronic device whose working can be demonstrated.

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 : 45 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

Semester-VI

20EPC601	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

20EPC602	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

20EPC608	POWER ELECTRONICS LABORATORY	L	T	P	C
		0	0	4	2

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 study the characteristics of AC voltage controller and SMPS
	To know the performances of resonant and quasi resonant converter.

LIST OF EXPERIMENTS

1. Characteristics of SCR, TRIAC and DIAC.
2. Characteristics of MOSFET and IGBT.
3. Determination of Control Characteristics of AC to DC fully controlled converter (1-phase and 3-phase).
4. Determination of Control Characteristics of AC to DC half controlled converter (1-phase and 3-phase).
5. Determination of Control Characteristics of Step down and Step up chopper.
6. IGBT based PWM inverter.
7. Series and Parallel inverter.
8. AC Voltage Controller.
9. Switched Mode Power Supply (Fly back, Forward and half Bridge Methods).
10. Cycloconverters.

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 half controlled converter and 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 single phase PWM inverter module / Discrete Component – 2
5. IGBT based three phase PWM inverter module / Discrete Component – 2
6. Switched mode power converter module/Discrete Component – 2
7. SCR &TRIAC based 1 phase AC controller along with lamp or rheostat load - 2
8. Cyclo converter kit with firing module – 2

9. Dual regulated Dc power supply with common ground

10. Cathode ray Oscilloscope –10

11. Isolation Transformer – 5

12. Single phase Auto transformer –3

13. Components (Inductance, Capacitance) 3 set for each

14. Multimeter – 5

15. LCR meter – 3

16. Rheostats of various ranges – 2 sets of 10 value

17. Work tables – 10

18. DC and AC meters of required ranges – 20

19. Component data sheets to be provided

TOTAL:60 PERIODS

OUTCOMES:	After successful completion of the course students able to
1.	Design conduct experiment on various converter
2.	Compare the characteristics of various power semiconductor devices.
3.	Demonstrate the operation of phase controlled rectifiers based DC drives.
4.	Analyze the basic topologies of DC-DC converters.
5.	Employ the different modulation techniques of pulse width modulated inverters.
6.	Compute the performance of AC voltage controller.

COURSE ARTICULATION MATRIX:

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

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

20EPC609	POWER SYSTEM LABORATORY I	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To measure electrical and mechanical quantities in Three Phase Circuits, transmission lines and underground cables.
- To model and simulate Power system components and renewable energy sources.
- To form network matrices and perform load flow and fault analysis.
- To analyse the stability of single machine infinite bus system

LIST OF EXPERIMENTS

1. Simulation of power, power factor and harmonics measurements in three phase circuits
2. Measurement of transmission line parameters
3. Simulation of Medium transmission Lines for power transfer calculations
4. Mechanical design of transmission lines
5. Measurement of underground cable parameters.
6. Modelling of power system components and simulate single line diagram.
7. Formation of network matrices
8. Load flow analysis using Gauss Seidal method
9. Load flow analysis using Newton Raphson method
10. Simulation of various faults in power systems
11. Stability analysis in Single machine infinite bus systems.
12. Modelling of renewable energy sources

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Power system software Package (MATLAB, MiPower etc.,)
2. Power system simulation Tool.

TOTAL:45 PERIODS

OUTCOMES: After successful completion of the course, students able to

1.	Simulate load flow and fault analysis in real time power networks.
2.	Design transmission lines and underground cables in real time
3.	Simulate the power networks integrated with renewable energy systems

COURSE ARTICULATION MATRIX

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

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

20EPR610	PROJECT II	L	T	P	C
		0	0	3	1.5

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 Mini-project work from the learning of subjects from semester one to semester five and carry out both design and fabrication of an Electrical and Electronic device whose working can be demonstrated. The design is expected to be completed in the Sixth semester itself.

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 PERIODS:45 PERIODS

OUTCOMES: After successful completion of the course, students 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

Semester-VII

20ZHS701	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

OBJECTIVES :	
1.	To enable the students to create an awareness on Engineering Ethics
2.	To study the engineering as social experimentation
3.	To impart knowledge on engineer's responsibility for safety
4.	To impart knowledge on engineer's responsibility and rights
5.	To study the global issues on business

UNIT I	ENGINEERING ETHICS	9

Sensesof'EngineeringEthics'–Varietyofmoralissues–Typesofinquiry–Moral dilemmas–Moral Autonomy–Kohlberg's theory–Gilligan's theory–Consensus and Controversy–Professions and Professionalism–Professional Ideals and Virtues–Uses of Ethical Theories.

UNIT II	ENGINEERINGASSOCIALEXPERIMENTATION	9

EngineeringasExperimentation–EngineersasresponsibleExperimenters–ResearchEthics –Codes of Ethics–Industrial Standards- A Balanced Outlook on Law–The Challenger Case Study.

UNIT III	ENGINEER'S RESPONSIBILITY FOR SAFETY	9

SafetyandRisk–AssessmentofSafetyandRisk–RiskBenefitAnalysis–ReducingRisk–The Government Regulator's Approach to Risk- Chernobyl Case Studies and Bhopal.

UNIT IV	RESPONSIBILITIES AND RIGHTS	9

CollegialityandLoyalty–RespectforAuthority–CollectiveBargaining–Confidentiality–Conflicts of Interest–Occupational Crime–Professional Rights–Employee Rights– Intellectual Property Rights(IPR) –Discrimination.

UNIT V	GLOBALISSUES	9

Multinational Corporations– Business Ethics-Environmental Ethics –Computer Ethics-Role in Technological Development– Weapons Development–Engineers as Managers–Consulting Engineers–Engineers as Expert Witnesses and Advisors–Honesty–Moral Leadership–Sample Code Conduct.

	TOTAL : 45 PERIODS

OUTCOMES:	After successful completion of the course students able to

1.	Apply the ethical theories in engineering environment.
2.	Analyze the risks and improve their responsibility for safety.
3.	Utilize their rights and improve responsibilities.
4.	Utilize their rights and improve rights.
5.	Propose remedies for global issues.

TEXT BOOKS:

1.	MikeMartinandRolandSchinzinger,"EthicsinEngineering",McGrawHill,NewYork(2005).
2.	Charles E Harris, Michael S Pritchard and Michael JRabins,"EngineeringEthics–ConceptsandCases",ThompsonLearning,(2000).
3.	David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press,(2003)

REFERENCES:

1.	*Charles D Fleddermann, "Engineering Ethics", Prentice Hall, NewMexico,1999.*
2.	*John R Boatright, "Ethicsandthe Conduct of Business", Pearson Education, 2003.*
3.	*Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.*
4.	*Prof. (Col)P S Bajaj and Dr.Raj Agrawal, "Business Ethics–An Indian Perspective", Biztantra, NewDelhi,2004.*
5.	*David Ermannand Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, 2003.*

COURSE ARTICULATION MATRIX

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

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

20EPC702	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

20EPC708	POWER SYSTEM LABORATORY II	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To model and simulate DC transmission system, Circuit breakers and FACTS devices.
- To solve unit commitment, economic load dispatch, state estimation and load forecasting problems.
- To design Load Frequency Controller in single area and two area systems
- To model and simulate the excitation systems in synchronous generator.
- To understand the operation of numerical relays and microgrid

LIST OF EXPERIMENTS

1. Simulation of DC transmission system
2. Simulation of Circuit Breakers (Air and Vacuum).
3. Solution of unit commitment problem
4. Solution of Economic Load dispatch
5. Load frequency Control of single area system
6. Load frequency Control of two area system
7. Simulation of Excitation Systems
8. Modelling of FACTS Devices
9. Solution of State Estimation Problem
10. Load forecasting problems
11. Study of numerical relays (Differential, Distance and OV/UV Protection)
12. Study of microgrid

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Power system software Package (MATLAB, MiPower etc.,)
2. Air Circuit Breaker
3. Vacuum Circuit Breaker
4. Percentage biased Differential relay testing bench (Numerical)
5. Over/Undervoltage relay integrated with test kit (Numerical)
6. Single phase Distance protection Relay test Bench (Numerical)
7. Power system simulation Tool.
8. Smart Grid Setup.

TOTAL:60 PERIODS

OUTCOMES: After successful completion of the course students able to

1. Apply circuit breakers and numerical relays in real time projects
2. Solve real time power system operation problems
3. Design the controller to regulate real and reactive power.
4. Apply FACTS devices in real time power systems

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		3									2	1	2	2	2
CO3		3									2	1	2	2	2
CO4		3									2	1	2	2	2

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

20EPR709	PROJECT III	L	T	P	C
		0	0	6	3

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 early in the seventh semester and carry out both design and fabrication of an Electrical and Electronic device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

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 in that any one review will be conducted with external examiner.

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 : 90 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

Semester-VIII

20EPR808	PROJECT IV	L	T	P	C
		0	0	12	6

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 early in the seventh semester and carry out both design and fabrication of an Electrical and Electronic device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

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 in that any one review will be conducted with external examiner.

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 : 180 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

20EPE001	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-fuuzy 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

20EPE002	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 SYSTEMS	09

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

20EPE003	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 pCO_2, pO_2

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

20EPE004	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

20EPE005	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

20EPE006	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, 5thEdition, 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

20EPE007	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

20EPE008	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

20EPE009	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

20EPE010	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

20EPE011	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
3.	Siegfried Heir, "Grid Integration of Wind Energy Systems", John Willey & Sons; 2nd Edition, 2006.

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.*

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

20EPE012	ADVANCED ELECTRIC DRIVES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the operation of power electronic converters and their control strategies.
- To study the vector control strategies for ac motor drives
- To study the modelling of induction motor drives
- To study the modelling of synchronous motor drives
- To study the implementation of DSP based motion control

UNIT I	POWER CONVERTERS FOR AC DRIVES	10

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with Self-commutated devices. Control of CSI, H bridge as a 4-Q drive.

UNIT II	INDUCTION MOTOR DRIVES	10

Different transformations and reference frame theory, Modelling of induction machines, Voltage fed inverter control-v/f control, vector control, direct torque and flux control (DTC).

UNIT III	SYNCHRONOUS MOTOR DRIVES	6

Modelling of synchronous machines, open loop v/f control, vector control, direct torque Control, CSI fed synchronous motor drives.

UNIT IV	PERMANENT MAGNET AND SWITCHED RELUCTANCE MOTOR DRIVES	10

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, Block diagrams, Speed and torque control in BLDC and PMSM. Evolution of switched reluctance motors, various topologies for SRM drives, comparison,Closed loop speed and torque control of SRM.

UNIT V	DSP BASED MOTION CONTROL	9

Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control

TOTAL : 45 PERIODS

OUTCOMES: After successful completion of the course students able to

1. Design power converters for ac drives.
2. Design induction motor drives
3. Design synchronous motor drives
4. Design permanent magnet and switched reluctance motor drives

5.	Demonstrate DSP based motion control
TEXT BOOKS:	
1	B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.
2	P. C. Krause, O. Wasynczuk and S. D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.
REFERENCES:	
1.	H. A. Taliyat and S. G. Campbell, "DSP based Electromechanical Motion Control", CRC press, 2003.
2.	R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC Press, 2009.
3.	NED Mohan, Advanced Electric Drives analysis control and modelling using MATLAB/Simulink by John Willey and son's 2016
4.	Jacek Kabzinski ,Advanced control of Electrical Drives and power electronic converters springer 2016
5.	De Doncker, Pulle,and Veltman ,Advanced Electrical drives Analysis,modelling and control springer 2011

COURSE ARTICULATION MATRIX

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

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

20EPE013	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

20EPE014	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

20EPE015	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

20EPE016	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

20EPE017	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

20EPE018	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*
4.	*Hemant Joshi Residential And Commercial Electrical Systems, McGraw Hill Education,2008.*
5.	*J.B.Gupta, Electrical installation estimating and costing, Kataria,S.K.,& Sons*

COURSE ARTICULATION MATRIX

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

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

20EPE019	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

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

20EPE020	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

20EPE021	SMART GRID	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the architecture of smart grid
- To study the smart grid communications and its measurement techniques
- To educate the students on load flow analysis in smart grid
- To impart knowledge on voltage stability in smart grid
- To introduce grid integration for renewable energy sources

UNIT I	SMART GRID ARCHITECTURE	9

Introduction – Comparison of Power grid with Smart grid – power system enhancement – communication and standards - General View of the Smart Grid Market Drivers - Stakeholder Roles and Function - Measures - Representative Architecture - Functions of Smart Grid Components-Wholesale energy market in smart grid-smart vehicles in smart grid.

UNIT II	SMART GRID COMMUNICATIONS AND ITS MEASUREMENT TECHNIQUES	9

Communication and Measurement - Monitoring, Phasor Measurement Unit (PMU), Smart Meters, Wide area monitoring systems (WAMS)- Advanced metering infrastructure- GIS and Google Mapping Tools.

UNIT III	LOAD FLOW ANALYSIS IN SMART GRID	9

Introduction to Load Flow Studies - Challenges to Load Flow in Smart Grid and Weaknesses of the Present Load Flow Methods - Load Flow State of the Art: Classical, Extended Formulations, and Algorithms –Load flow for smart grid design-Contingencies studies for smart grid.

UNIT IV	SMART GRID STABILITY	9

Voltage Stability Analysis Tools-Voltage Stability Assessment Techniques-Voltage Stability Indexing-Application and Implementation Plan of Voltage Stability in smart grid-Angle stability assessment in smart grid-Approach of smart grid to State Estimation-Energy management in smart grid.

UNIT V	GRID INTEGRATION WITH RENEWABLE ENERGY	9

Renewable Energy Resources-Sustainable Energy Options for the Smart Grid-Penetration and Variability Issues Associated with Sustainable Energy Technology-Demand Response Issues-Electric Vehicles and Plug-in Hybrids-PHEV Technology-Environmental Implications-Storage Technologies-Grid integration issues of renewable energy sources.

TOTAL :45 PERIODS

OUTCOMES: After successful completion of the course students able to

1.	Explain the concepts and design of Smart grid
2.	Explain the various communication and measurement technologies in smart grid
3.	Perform load flow in smart grid.
4.	Analyze the stability of smart grid.
5.	Integrate the renewable energy resources and storages with smart grid

TEXT BOOKS:	
1.	Stuart Borlase "Smart Grid: Infrastructure, Technology and Solutions", CRC Press 2012.
2.	Janaka E kanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications",Wiley2012.
REFERENCES:	
1.	*Vehbi C.Güngör, Dilan Sahin, Taskin Kocak, SalihErgüt, Concettina Buccella, CarloCecati, and Gerhard P. Hancke, "Smart Grid Technologies: Communication Technologies and Standards" IEEE Transactions On Industrial Informatics, Vol.7,No.4, November2011.*
2.	*Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid –The New and Improved PowerGrid: ASurvey",IEEE Transaction on Smart Grids,vol.14,2012.*
3.	*James Momoh,Smart Grid fundamentals of design and analysis by Wiley2012*
4.	*Stuart Borlasa Smart grid "Infrastructure,Technology and solutions* ", CRC Press 2012.
5.	*Lars .T.Berger Smart grid Applications,Communications and security by Willey 2012*

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	
CO3											1		1		
CO4		1			2								2		
CO5	3							1							2

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

20EPE022	FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING	L	T	P	C
		2	1	0	3

OBJECTIVES:

- To Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
- To Analyse discrete-time systems using z-transform.
- To Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
- To Design digital filters for various applications.
- To Apply digital signal processing for the analysis of real-life signals.

UNIT I	DISCRETE TIME SIGNALS AND SYSTEMS	09

Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate

UNIT II	Z TRANSFORM	09

z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z transforms.

UNIT III	DISCRETE FOURIER TRANSFORM	09

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

UNIT IV	DESIGN OF DIGITAL FILTERS	09

Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and High pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

UNIT V	APPLICATIONS OF DIGITAL SIGNAL PROCESSING	09

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

TOTAL :45 PERIODS

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

1.	Apply discrete signals and systems to Electrical systems
2.	Apply Z -Transform in signal processing
3.	Apply discrete fourier transform for processing discrete signals
4.	Design the digital FIR and IIR filters using various methods
5.	Apply digital signal processing technique in real time applications

TEXT BOOKS:

1.	*J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall, 1997.*
2.	*A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.*

REFERENCES:	
1.	*L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992.*
2.	*J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.*
3.	*D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.*
4.	*S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.*
5.	*Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning,2014.*

COURSE ARTICULATION MATRIX

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

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

20EPE023	DSP INTERFACING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the design of microcontroller 8051 and apply to various power electronic circuits.
- To understand the concepts of code composer studio.
- To understand the process of debugging.
- To understand the need and design of DSP Interface.
- To acquire the knowledge about the registers and applications of DSP in Power electronic circuits.

UNIT I	MICRO CONTROLLER 8051	9

Microcontroller 8051 – Special Function Registers – Interfacing with external memory – Programmable built-in ports – On-chip counters/timers – Serial Data Input/output – Interrupts – Assembly language Programming and applications.

UNIT II	CODE COMPOSER STUDIO	9

Code Composer Studio: Glossary – Definitions – Abbreviations – Overview – System Requirements – Eclipse – Licensing – Contents – Debug Probes – Support – Installation – Important Installation Information – Installation Process – Command Line Installation – Uninstalling CCS

Getting Started – Getting Started View – Resource Explorer – Device Family Specific Information – Importing a CCS Project – Creating a New CCS Project – Building and Running Your Project – Customizing the Environment – Projects and Build – Creating and Managing Projects– Building Projects – Creating and Building Projects from Command Line – System Projects – Working with Source Control – Understanding Tools Versioning – Troubleshooting – Analysis and Optimization Tools – References

UNIT III	DEBUG	9

Debug Overview – Configuring the debugger – Launching a debug session – Debugging the application – Advanced debugging topics – Scripting – Graph Tools – Image Analyzer – The General Extension Language (GEL) – References

UNIT IV	NEED OF DSP	9

Need of Digital Signal Processor (DSP) – Examples of TI DSP family – Comparison of different DSPs of TI – Architecture of DSP TMS 320 F2812 – Pin diagram – Main features – Block diagram – Peripherals as CPU timers – Event managers – ADC – Enhanced controller area network (eCAN) – Serial communication interface modules – Digital i/o and shared pin functions – Serial peripheral interface module – PIE block.

UNIT V	REGISTERS AND DSP APPLICATIONS FOR POWER ELECTRONICS	9

Register Functional Overview – Register Bits I/O Mapping – PLL based Modes of Operation – PLL Control Register (PLLCR) field Description – Peripheral Clock Control – High-Speed Peripheral Clock Prescaler (HISPCP) Register – Watchdog Block – EALLOW Protected Registers – All GP registers – GP Timers – Compare units – Timer operating modes – DBTCON register – PWM waveform generation and programming. Applications of Digital Signal Processor in Power Electronics converters and drives – DSP based controller for PE and Drives.
TOTAL: 45 PERIODS

OUTCOMES: After completion of this course, the student will be able to:	
1.	Develop program in microcontroller to control converters and inverters
2.	Develop the project with Code Composer Studio
3.	Design the debugger and Debug the applications with DSP
4.	Interface the DSP TMS 320 F2812 with various applications
5.	Configure different registers in DSP TMS 320 F2812 and Apply the DSP in Converters and Inverters.

TEXTBOOKS:	
1.	Ayala, J. Kenneth, “The 8051 Microprocessor Architecture, Programming and Applications”, Penram International, 1996.
2.	Trevor Martin, "The Insider's Guide To The Philips ARM7-Based Microcontrollers", Published by Hitex (UK) Ltd, April 2005.
3.	Muhammad Ali Mazidi, “The 8051 Microcontroller And Embedded Systems Using Assembly And C, 2/E”, Pearson Education India, 01-Sep-2007.

REFERENCES:	
1.	*eZdspTM F2812 technical reference.*
2.	*TMS320x281x DSP Event Manager (EV) Reference Guide*
3.	*TMS320x281x DSP Data manual.*
4.	https://software-dl.ti.com/ccs/esd/documents/users_guide/index.html

COURSE ARTICULATION MATRIX

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

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

20EPE024	FPGA INTERFACING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the architecture of FPGA
- To develop the programs with FPGA
- To design application specific ICs and program with them
- To acquire the knowledge about the hardware elements required for FPGA interface
- To understand the concept of pulse with modulation for various converters and inverters.

UNIT I	INTRODUCTION	9

Field Programmable Gate Arrays – Introduction to FPGA – Logic Block Architecture – Routing Architecture – Programmable Interconnections – Design Flow – Xilinx Spartan architecture – Xilinx Virtex Architecture – Altera

UNIT II	PROGRAMMING	9

Programming FPGA – Constraints – STA – Timing closure – Case study

UNIT III	APPLICATION-SPECIFIC INTEGRATED CIRCUITS	9

ASIC Design – Custom IC Design Flow – Logical and physical design steps – Standard cells – ASIC Cell libraries – Gate Array Designs – Programming Technologies – Introduction to IP cores

UNIT IV	HARDWARE DESIGN	9

Basic concepts of hardware design – clock frequency – Latency and pipelining – Throughput – Memory architecture and layout – Vivado High-Level synthesis: Operation – Conditional statements – Loops – Functions – Dynamic memory allocation – Pointer.

UNIT V	PULSE WIDTH MODULATION	9

PWM Generation for Converters and Inverters – Multilevel inverters

TOTAL: 45 PERIODS

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

1.	Explain the architecture of FPGA
2.	Develop the program with FPGA
3.	Develop the program with ASIC
4.	Interface various elements with FPGA
5.	Design PWM controllers for converters and inverters

TEXTBOOKS:

1.	Zainalabedin Navabi, VHDL. Analysis and Modelling of Digital Systems, McGraw-Hill

2.	M.J.S. Smith, - "Application - Specific Integrated Circuits" - Addison –Wesley Longman Inc, 1997
REFERENCES:	
1.	https://www.xilinx.com/support/documentation/sw_manuals/ug998-vivado-intro-fpga-design-hls.pdf

COURSE ARTICULATION MATRIX

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

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

20EPE025	REAL TIME INTERFACING AND PROCESSING FOR POWER ELECTRONICS APPLICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the design of various sensor circuits.
- To understand the design of GATE drive circuit.
- To understand the design of Microcontroller 8051/PIC16F877/ATMEGA application board.
- To understand the design of SMPS for converters and inverters.
- To understand the design of sensors for DC/DC converters.

UNIT I	SENSORS AND ITS CIRCUIT DESIGN	9

Design of sensor circuits for AC and DC Voltage & Current measurements - LV25P and LA55P – Study of Temperature, Speed, Torque, Frequency, Phase Angle and Pressure Sensors with real-time IC's - Real-time Clock

UNIT II	GATE DRIVE CIRCUIT	9

Gate Drive Circuit design using optocouplers for MOSFET, IGBT, SiCMOSFET – Design of Line synchronization UJT firing circuit for SCR

UNIT III	MICROCONTROLLER 8051	9

Microcontroller 8051/PIC16F877/ATMEGA application board design

UNIT IV	SMPS DESIGN	9

SMPS Design for DC to DC converters and DC to AC Inverters

UNIT V	SENSORS IN CONVERTER CIRCUITS	9

Design of voltage and current sensor circuits for DC to DC converters with closed-loop applications.

TOTAL: 45 PERIODS

OUTCOMES:

1.	To understand the design of various sensor circuits.
2.	To understand the design of GATE drive circuit.
3.	To understand the design of Microcontroller 8051/PIC16F877/ATMEGA application board.

4.	To understand the design of SMPS for converters and inverters.
5.	To understand the design of sensors for DC/DC converters.
TEXTBOOKS:	
1.	Robert W. Erickson and Dragan Maksimovic, “Fundamentals of Power Electronics”, Second Edition. Secaucus, NJ, USA: Kluwer Academic Publishers, 2000.
2.	Muhammad Ali Mazidi, “The 8051 Microcontroller And Embedded Systems Using Assembly And C, 2/E”, Pearson Education India, 01-Sep-2007.
REFERENCES:	
1.	*LV55P voltage sensor datasheet*
2.	*LA55P current sensor datasheet*
3.	*HCPL3120 and TLP350 datasheets*

COURSE ARTICULATION MATRIX

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

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

LIST OF OPEN ELECTIVES OFFERED BY EEE DEPARTMENT

20EOE001	MATLAB PROGRAMMING	L	T	P	C
		2	0	1	3

OBJECTIVES:

- To study basics of MATLAB programming
- To introduce MATLAB Functions and File processing
- To impart knowledge on MATLAB programming techniques
- To enable the students to plot the functions using MATLAB
- To develop skill in simple engineering applications development with MATLAB

UNIT I	INTRODUCTION	9

Basics of MATLAB programming–Variables and Arrays – initializing variables in MATLAB – Multidimensional Arrays – Sub arrays – Special Values–Displaying Output Data – Data Files – Scalar and Array Operations – Hierarchy of Operations

UNIT II	FUNCTIONS & FILES	9

Built-in MATLAB Functions – Elementary Mathematical Functions – User Defined Functions – Binary I/O Functions – Advanced Function Programming – Introduction to MATLAB File Processing – File Opening and Closing, Working with Data Files.

UNIT III	PROGRAMMING TECHNIQUES	9

Program Design and Development–Relational Operators and Logical Variables–Logical Operators and Functions–Conditional Statements–Loops–The Switch Structure–Debugging MAT LAB Program.

UNIT IV	PLOTTING OF FUNCTIONS	9

XY plotting functions– Subplots and Overlay plots–Plots With Error Bars– Special Plot types– Polar Plot– Interactive plotting– Putting Multiple Plots on the Same Page– Function Discovery– Regression– 3-D plots–Mesh and Surface Plots – Examples of MATLAB Applications– Problems-GUI.

UNIT V	ENGINEERING APPLICATIONS	9

Numerical Differentiation in single variable,: Higher derivatives, multiple variables, Newton-Cotes integration formulae, MATLAB functions for integration, Linear algebra in MATLAB, Gauss Elimination, LU decomposition and partial pivoting, Iterative methods: Gauss Siedel, Special Matrices: Tri- diagonal matrix algorithm- Engineering Applications-Optimization.

	TOTAL :45 PERIODS

OUTCOMES: After successful completion of the course students able to

1.	Articulate importance of MATLAB software's in research by simulation work
2.	Demonstrate the Basics of MATLAB programming tools, functions and files that are essential in solving engineering problems
3.	Explain about programming techniques and plotting of functions.
4.	Illustrate the loops and Debugging of MAT LAB Programs
5.	Develop the writing of programs & simulation in MATLAB for engineering problems.

TEXT BOOKS:

1.	Amos Gilat, MATLAB An Introduction With Applications By, Wiley Publication. 6th edition, 2016
2.	Rudra Pratap , "MATLAB 7" , Oxford University Press,2006
3	R.K. Bansal, A.K. Goel , "MATLAB and Its Applications In Engineering" Dorling kindeslay pvt. Lt, india, 2009.

REFERENCES:

1.	*Stephen j. Chapman., "MATLAB programming for engineers ", Fifth Education, United States of America, 2015.*
2.	*Otto S.R, Denier J.P., "An introduction to programming and numerical methods in MATLAB ", Springer –verlag London limited.2005.*
3.	*William J. Palm III "Introduction to MATLAB for Engineers", Published February 1st 2010 by McGraw-Hill Education.*
4.	*Brian R. Hunt (Editor),Ronald L. Lipsman, J. Rosenberg"A Guide to MATLAB: For Beginners and Experienced Users"Published August 6th 2001 by Cambridge University Press.*
5.	*Edward B. Magrab " An Engineers Guide to MATLAB ",Pearson; 1 edition (11 August 2000)*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1					3		1				3	2	2		
CO2	2		3								2			3	
CO3	2		3			1							2		
CO4		2		3		1							2		
CO5			2		2						2				3

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

20EOE002	RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

OBJECTIVES:	
•	To introduce Different types of Renewable Energy Sources
•	To educate the students on principle of solar energy
•	To educate the students on wind energy conversion systems
•	To educate the students on biomass energy and cogeneration systems
•	To impart knowledge on tidal energy and geothermal energy

UNIT I	INTRODUCTION	9

Energy Conservation and Energy Efficiency – Needs and Advantages, Different types of Renewable Energy Sources - Energy Resources Availability in World –Environmental aspects of energy utilization – Energy Conservation Act 2003 - Statistical Report on Renewable energy scenario in India - Applications.

UNIT II	SOLAR ENERGY	9

Solar Flat plate and concentrating collectors – Solar heating and cooling techniques –Solar desalination – Solar Pond – Solar cooker – Solar Drying – Solar pumping – Solar thermal power plant – Solar photo voltaic conversion – Solar cells – PV applications.

UNIT III	WIND ENERGY	9

Wind energy estimation in World and in India – Types of wind energy systems –Performance of Wind energy System– Details of wind turbine generator – Safety and Environmental Aspects.

UNIT IV	BIOMASS ENERGY	9

Biomass direct combustion – Biomass gasifier – Biomass: Types – Advantages & Drawbacks - Biogas plant – Ethanol production – Bio diesel – Cogeneration: steam turbine cogeneration systems, gas turbine cogeneration systems, reciprocating IC engine cogeneration systems, combined cycle cogeneration systems – Applications of Cogeneration in utility sector – Biomass applications.

UNIT V	OTHER RENEWABLE ENERGY SOURCES	9

Tidal energy – Wave energy – Open and closed OTEC Cycles – Small hydro –Geothermal energy – Fuel cell systems - Stirling Engines.

	TOTAL :45 PERIODS

OUTCOMES:	After successful completion of the course students able to

1.	Explain the importance of renewable energy source
2.	Explain and illustrate the Solar Energy.
3.	Explain and illustrate the Wind Energy
4.	Explain and illustrate the Biomass Energy
5.	Explain and illustrate about all renewable Energy Sources.

REFERENCES:

1.	*G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 1999.*
2.	*S.P. Sukhatme, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.*
3.	*G.N. Tiwari, Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.*
4.	*Solar Energy: Principles of Thermal Collection and Storage, McGraw-Hill Education (India) (13 January 2009)*
5.	*John Twidell, Renewable Energy Resources, Routledge; 2 edition (24 November 2005)*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2					2		2				1			2
CO2				1					2					2	
CO3				1					2					2	
CO4				1					2					2	
CO5			2					2				2		2	

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

20EOE003	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the forms of energy, energy auditing types and roles of energy managers
- To impart knowledge on energy costing and importance of power factor in energy cost
- to study metering for energy management & power quality analyses
- To educate the students on different lighting systems
- To study energy economics techniques

UNIT I	INTRODUCTION	9

Types & Forms of Energy - Primary / Secondary Energy Sources –EC Act 2003 – Energy Auditing: Types, Classifications, Deliverables, Barriers – Benchmarking - Roles & Responsibility of Energy Managers.

UNIT II	ENERGY COSTING, MONITORING &TARGETING	9

Data & Information Analysis – Cost / Energy Share Diagram – Data Graphing – Electricity Billing : Components & Costs – KVA – Need & Control – Determination of KVA demand & Consumption –Time of Day Tariff – Power Factor Basics – Penalty Concept for PF – PF Correction – Wheeling and Banking - Demand Side Management – comparison on unit cost of power cost from various sources – steam cost from different sources.

UNIT III	METERING FOR ENERGY MANAGEMENT & POWER QUALITY ANALYSES	9

Instruments Used in Energy systems: Load and power factor measuring equipment, Wattmeter, Flue gas analysis, Temperature and thermal loss measurements, Air quality analysis-Relationships between parameters-Units of measure-Typical cost factors- Utility meters – Timing of meter disc for kilowatt measurement - Demand meters - Paralleling of current transformers - Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements – Net metering - Metering techniques and practical examples.

UNIT IV	LIGHTING SYSTEMS & COGENERATION	9

Concept of lighting systems - The task and the working space - Light sources - Ballasts -Luminaries - Lighting controls - Optimizing lighting energy - Power factor and effect of harmonics on power quality - Cost analysis techniques - Lighting and energy standards Cogeneration: Forms of cogeneration - feasibility of cogeneration- Electrical interconnection.

UNIT V	ECONOMICS	9

Energy Economics – Depreciation - Financial Analysis Techniques – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing – ESCO concept – CUSUM Technique – ESCO Concept – ESCO Contracts.

	TOTAL : 45 PERIODS
OUTCOMES:	After successful completion of the course students able to
1.	Analyse the energy data of industries.
2.	Carry out energy accounting and balancing.
3.	Suggest methodologies for energy saving.
4.	Design Lighting systems
5.	Explain the concepts of Energy Economics
TEXT BOOKS:	
1.	Energy Manager Training Manual (4Volumes) available at www.Energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India. 2004.
2.	Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
3.	Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006.
REFERENCES:	
1.	*L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.*
2.	*Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford,1981*
3.	*Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists, Logman Scientific & Technical, ISBN-0-582-03184, 1990.*
4.	*WC Turner: Energy Management Handbook, Seventh Edition, (Fairmont Press Inc., 2007)*
5.	*Barun Kumar De, Energy Management, Audit and Conservation, Vrinda Publications P Ltd.; 2e edition (April 28, 2014)*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2		1						2				2		2
CO3			2		1						2				2
CO4		3	2								3				2
CO5			2		1						2				2

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

20EOE004	RELIABILITY ENGINEERING	L	T	P	C
		2	1	0	3

OBJECTIVES:

- Understand the concepts of Reliability, failures and Unreliability
- Understand various Design techniques for reliability
- To know various models and m order systems for analysing reliability
- To understand the economic issues and management techniques

UNIT I	CONCEPTS OF RELIABILITY	9

Reliability and Quality – Failures and Failure modes – Causes of Failures and Unreliability – Maintainability Function – Availability Function – Frequency of Failures – Two Unit Parallel system with Repair – Preventive Maintenance

UNIT II	DESIGN FOR RELIABILITY	9

Designing for Higher reliability – Redundancy techniques – Component versus Unit redundancy – Weakest Link Techniques – Mixed and standby Redundancy – Redundancy Optimization – Double Failures – Equipment Hierarchy – Logic diagram and Conditional Probability Approach.

UNIT III	RELIABILITY MODELS	9

Component Reliability – Meant Time to Failure – Time dependent and Stress dependent Hazard Models – Systems with Components in series and Parallel – k out of m systems – Nonseries–Parallel Systems System with Mixed mode failures

UNIT IV	M ORDER SYSTEMS	9

Non-maintained systems – Maintained systems – Trichotomous systems – Parameters of Dependency – Analysis of Non-maintained Systems with dependant units – Systems with Repair – Optimal Maintenance Policy.

UNIT V	ECONOMICS AND MANAGEMENT	9

Economics Issues – Manufacturer's Cost and Customers Cost – Cost Models – Reliability Programme – Management Policies and Decisions – Management by Objectives – Reliability group – Reliability Data – Managing People for reliability.

TOTAL : 45 PERIODS

OUTCOMES: After successful completion of the course students able to

1.	Analyse with reliability and quality with failures
2.	Apply various redundancy techniques for reliability
3.	Analyse the Component reliability and mean time to failure for various reliability model and m order systems with non-identical and dependant units
4.	Optimize the concepts of reliability with failures and manage the team for reliability
5.	Analze the cost effectiveness of products

TEXT BOOKS:

1.	E.Balaguruswamy, "Reliability Engineering", Tata McGraw Hill, Sixteenth Reprint, 2016.
2.	L.S.Srinath, "Reliability Engineering", Affiliated East-West Press, 3rd Edition, 1991.

REFERENCES:	
1.	Elasayed A.Elsayed, "Wiley Press, Second Edition, 2012
2.	K.K.Aggarwal, "Reliability Engineering", Kluwer Academic Publishers,1993
3.	*A.K. Govil, Reliability Engineering, McGraw-Hill Inc.,US (1 September 1983)*
4.	*E Balagurusamy, Reliability Engineering , McGraw Hill Education (1 July 2017)*
5.	*Massimo Lazzaroni , Reliability Engineering: Basic Concepts and Applications, Softcover reprint of the original 1st ed. 2011 edition (23 August 2016)*

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

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

20EOE005	DISASTER MANAGEMENT AND MITIGATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Understand basic concepts in Disaster Management
- To Understand Definitions and Terminologies used in Disaster Management
- To Understand Types and Categories of Disasters
- To Understand the Challenges posed by Disasters
- To understand Impacts of Disasters Key Skills

UNIT I	INTRODUCTION	9

Concepts and definitions: disaster, hazard, vulnerability, risks – Severity – Frequency and details – Capacity – Impact – Prevention – Mitigation).

UNIT II	DISASTERS	9

Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.) – Manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.) – Hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

UNIT III	DISASTER IMPACTS	9

Disaster impacts (environmental, physical, social, ecological, economic, political, etc.) – Health, psycho – Social issues – Demographic aspects (gender, age, special needs) – Hazard locations – Global and national disaster trends – Climate change and urban disasters.

UNIT IV	DISASTER RISK REDUCTION	9

Disaster management cycle – its phases – Prevention, mitigation, preparedness, relief and recovery – Structural and non-structural measures – Risk analysis, vulnerability and capacity assessment – Early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications) – Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders – Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

UNIT V	DISASTERS, ENVIRONMENT AND DEVELOPMENT	9

Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

TOTAL : 45 PERIODS

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

1.	Develop the application of Disaster Concepts to Management
2.	Develop the Relationship between Development and Disasters
3.	Develop the Disaster impacts
4.	Develop the Disasters Risk Reduction
5.	Realize of the responsibilities to society

TEXT BOOKS:

1.	Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
2.	Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
3.	Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation

REFERENCES:

1.	*Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003*
2.	*Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC*
3.	*http://ndma.gov.in/ (Home page of National Disaster Management Authority)*
4.	*http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).*
5.	*R. B. Singh, Natural Hazards and Disaster Management: Vulnerability and Mitigation Rawat; Reprint edition (1 December 2006)*

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

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

20EOE006	POWER ELECTRONICS AND DRIVES	L	T	P	C
		3	0	0	3

OBJECTIVES:	
●	Understand the operation of power electronic converters and their control strategies.
●	Understand the vector control strategies for ac motor drives
●	Understand the implementation of the control strategies using digital signal processors
●	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.

UNIT I	POWER SEMICONDUCTOR DEVICES	9

Diode – BJT – Thyristor – GTO, MCT,FCT,RCT – 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	POWER ELECTRONIC CIRCUITS	9

Fundamental of Converters – Single phase and three phase Converters – Controlled and uncontrolled rectifiers – Principle of Inverters – Single phase and three phase inverters – VSI and CSI – Voltage controllers – DC-DC Converters – Cyclo converters

UNIT III	DC AND AC DRIVES	9

Steady state analysis of Three phase converter fed separately excited DC motor Drive – Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive – Stator voltage control – Energy efficient drive – V/f control – Voltage / current fed inverter – Closed loop control – V/f control and self-control of synchronous motor

UNIT IV	SPECIAL ELECTRIC DRIVES	9

Solar and battery powered Drives - Traction Drives Servo motor drive requirement – control and implementation – Stepper Motor Drive – Control and Applications – Permanent magnet synchronous motor

UNIT V	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

TOTAL : 45 PERIODS

OUTCOMES:	After successful completion of the course, The student will develop competencies in
1.	Apply power semiconductor devices for various applications
2.	Design and analyze power electronic circuits
3.	Design and apply power electronic circuits for various DC and AC electric drives
4.	Design and apply power electronic circuits for special electric drives such as stepper motor and synchros etc..,
5.	Select the type of machine or drive for particular application to match the characteristics of loads

TEXT BOOKS:	
1.	M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
2.	Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992
REFERENCES:	
1.	*Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002*
2.	*R.Krishnan, Electric Motor & Drives: Modelling, Analysis and Control, Prentice hall of India, 2001.*
3.	*Bimal K. Bose , Modern Power Electronics and AC Drives , Prentice Hall (12 October 2001)*
4.	*Singh, Advance Semiconductor Devices, Vei (2012)*
5.	*Tomasi, Advanced Electronic Communications Systems, Prentice Hall India Learning Private Limited; 6 edition (2004)*

COURSE ARTICULATION MATRIX

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

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