PONNAIYAH RAMAJAYAM INSTITUTE OF SCIENCE & TECHNOLOGY (PRIST)

Declared as DEEMED-TO-BE-UNIVERSITY
U/s 3 of UGC Act, 1956

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

PROGRAM HANDBOOK

B.Tech PART TIME

[Regulation2024]

[for candidates admitted to B.Tech EEE program from June2024 onwards]

PROGRAMME EDUCATIONAL OBJECTIVES:

PEO1: To enable graduates to pursue research, or have a successful career in academia or industries associated with Electronics and Communication Engineering, or as entrepreneurs.

PEO2: To provide students with strong foundational concepts and also advanced techniques and tools in order to enable them to build solutions or systems of varying complexity.

PEO3: To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problemsidentified.

PROGRAMME OUTCOMES:

Engineering Graduates will be able to:

A. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

B. **Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.**

C. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

D. **Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.**

E. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

F. **The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilitiesrelevant to the professional engineering practice.**

G. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

H. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

I. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

J .Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

K.Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

L.Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMM OUTCOMES												
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**
1	3	3	2	3	2	1	1	2	1	1	3	1	3
2	3	3	3	3	3	1	1	1	1	1	1	2	2
3	3	3	3	3	3	2	2	3	1	2	2	2	2

COURSE STRUCTURE

B.TECH PT

EEE

R 2024

B.Tech (PT) EEE R 2024(R)

SEMESTER I

Sl.No	Subject Code	Subject Name	Periods Per Week			C
			L	T	P	
1	24148S11P	Transforms and Partial Differential Equations	3	1	0	4
2	24153C12P	Control System	3	1	0	4
3	24153C13P	Circuit Theory	3	1	0	4
4	24153C14P	Electron devices and circuits	3	0	0	3
5	24153C15P	Electrical Machines-I	3	0	0	3
Total No of Credits						**18**

SEMESTER II

S. No	Subject Code	Subject Name	Periods Per Week			C
			L	T	P	
1	24148S21P	Numerical Methods	3	1	0	4
2	24150S22	Problem Solving and Python programming	3	0	0	3
3	24153C23P	Electrical Machines-II	3	0	0	3
4	24153C24P	Transmission and Distribution	3	0	0	3
5	24150L25	Problem Solving and Python Programming Laboratory	0	0	4	2
Total No of Credits						**15**

SEMESTER III

S. No	Subject Code	Subject Name	Periods Per Week			C
			L	T	P	
1	24148S31CP	Probability and Statistics	3	1	0	4
2	24153C32P	Linear Integrated Circuits and Applications	3	0	0	3
3	24153C33P	Power Electronics	3	0	0	3
4	24153C34P	Measurements and Instrumentation	3	0	0	3
5	24153L35P	DC and AC Electrical Machines Laboratory	0	0	4	2
Total No of Credits						**15**

SEMESTER IV

S. No	Subject Code	Subject Name	Periods Per Week			C
			L	T	P	
1	24153C41P	Protection and switchgear	4	0	0	3
2	24153C42P	High Voltage DC Transmission	3	1	0	4
3	24153C43P	Solid State Drives	3	1	0	4
4	24153E44_P	Elective–I	3	0	0	3
5	24153L45P	Control and Instrumentation Laboratory	0	0	4	2
Total No of Credits						**16**

SEMESTER V

S. No	Subject Code	Subject Name	Periods Per Week			C
			L	T	P	
1	24153C51P	Power System Analysis	3	1	0	4
2	24153C52P	Power Quality	3	1	0	4
3	24153C53P	Special Electrical Machines	3	1	0	4
4	24153E54_P	Elective –II	3	0	0	3
5	24153L55P	Power Electronics and Drives Lab	0	0	3	2
Total No of Credits						**17**

SEMESTER VI

S. No	Subject Code	Subject Name	Periods Per Week			C
			L	T	P	
1	24153C61P	Utilization of Electrical Energy	3	1	0	4
2	24153C62P	Digital Electronics	3	1	0	4
3	24153C63P	Power System Operation And Control	4	0	0	4
4	24153E64_P	Elective –III	4	0	0	4
5	24153L65P	Power Systems Lab	0	0	3	2
Total No of Credits						**18**

SEMESTER VII

S. No	Subject Code	Subject Name	Periods Per Week			C
			L	T	P	
1	24160S71P	Total Quality Management	3	0	0	3
2	24153C72P	Electrical Machine Design	3	1	0	4
3	24153C73P	Power Plant Engineering	4	0	0	4
4	24153E74P	Elective –IV	4	0	0	4
5	24153P75P	Project Work	0	0	12	6
Total No of Credits						**21**

LIST OF ELECTIVES

ELECTIVE–I (IV SEMESTER)

S. No	Subject Code	SubjectName	Periods Per Week			C
			L	T	P	
1	24153E44AP	Energy Management and Auditing	4	0	0	4
2	24153E44BP	Fuzzy Logic and its applications	4	0	0	4
3	24153E44CP	Bio Medical Instrumentation	4	0	0	4
4	24153E44DP	Modeling and Simulation Of Solar EnergySystems	4	0	0	4
5	24153E44EP	Non conventional energy system &Applications	4	0	0	4
6	24153E44FP	HVDC and FACTS	4	0	0	4
7	24153E44GP	Power Electronics for Renewable Energy Systems	4	0	0	4

ELECTIVE–II (V SEMESTER)

S. No	Subject Code	SubjectName	Periods Per Week			C
			L	T	P	
1	24153E54AP	Environmental Science and Engineering	4	0	0	4
2	24153E54BP	Artificial Neural Networks	4	0	0	4
3	24153E54CP	VLSI Design	4	0	0	4
4	24153E54DP	Robotics	4	0	0	4
5	24153E54EP	Multilevel Power Converters	4	0	0	4
6	24153E54FP	Sustainable and Environmental Friendly HV Insulation System	4	0	0	4
7	24153E54GP	Machine Monitoring System	4	0	0	4

ELECTIVE–III (VI SEMESTER)

S. No	Subject Code	Subject Name	Periods Per Week			C
			L	T	P	
1	24153E64AP	Principles of Management	4	0	0	4
2	24153E64BP	Micro Electro Mechanical Systems	4	0	0	4
3	24153E64CP	Integrated opto-Electronic Devices	4	0	0	4
4	24153E64DP	Computer Aided Design of Electrical Apparatus	4	0	0	4
5	24153E64EP	Advanced DC-AC Power conversion	4	0	0	4
6	24153E64FP	Embedded Control for Electric Drives	4	0	0	4
7	24153E64GP	Hybrid Energy Technology	4	0	0	4

ELECTIVE–IV(VII SEMESTER)

S. No	Subject Code	Subject Name	Periods Per Week			C
			L	T	P	
1	24153E74AP	Power system transients	3	0	0	3
2	24153E74BP	EHVAC and DC Transmission systems	3	0	0	3
3	24153E74CP	Fundamentals of Nano science	3	0	0	3
4	24153E74DP	Advanced Control systems	3	0	0	3
5	24153E74EP	Switched Mode Power supplies	3	0	0	3

6	24153E74FP	Intelligent Control of Electric Vehicles	3	0	0	3
7	24153E74GP	Design of Electric Vehicle Charging System	3	0	0	3

Credit Distribution

Sem.	Core Courses				Elective Courses		Total Credits
	Theory Courses		Practical Courses				
	Nos.	Credits	Nos.	Credits	Nos.	Credits	
I	05	18	-	-	-	-	18
II	04	13	01	02	-	-	15
III	04	13	01	02	-	-	15
IV	03	11	01	02	01	03	16
V	03	12	01	02	01	03	17
VI	03	12	01	02	01	04	18
VII	03	11	01	06	01	04	21
Total Credits							**120**

24148S11P-TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

3 1 0 4

(Common to all) **SEMESTER-1**

COURSE OBJECTIVES :

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I FOURIER SERIES 9 + 3hrs

Periodic function-Graph of functions- 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 II FOURIER TRANSFORM 9 + 3hrs

Fourier integral theorem (without proof) – Sine and Cosine transforms – Properties (without Proof) – Transforms of simple functions – Convolution theorem – Parseval's identity – Finite Fourier transform, Sine and Cosine transform.

UNIT III Z -TRANSFORM AND DIFFERENCE EQUATIONS 9 + 3hrs

Z-transform - Elementary properties (without proof) – Inverse Z – transform – Convolution theorem -Formation of difference equations – Solution of difference equations using Z –transform- Sampling of signals –an introduction.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS 9 + 3hrs

Formation of pde –solution of standard type first order equation- Lagrange's linear equation – Linear partial differential equations of second order and higher order with Constant coefficients.

UNIT V BOUNDARY VALUE PROBLEMS 9 + 3hrs

Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates. **Total no of hrs: 60hrs**

COURSE OUTCOMES

- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand 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.

- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS

1. Andrews, L.A., and Shivamoggi B.K., "Integral Transforms for Engineers and Applied

   Mathematicians", Macmillen , New York ,2288.

2. Grewal, B.S., "Higher Engineering Mathematics", Thirty Sixth Edition, Khanna Publishers,

   Delhi, 2001.

3. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., "Engineering Mathematics Volume

   III", S. Chand & Company ltd., New Delhi, 1996.

REFERENCE BOOKS

1. Narayanan, S., Manicavachagom Pillay, T.K. and Ramanaiah, G., "Advanced Mathematics for Engineering Students", Volumes II and III, S. Viswanathan (Printers and Publishers) Pvt. Ltd. Chennai, 2002.

2. Churchill, R.V. and Brown, J.W., "Fourier Series and Boundary Value Problems", Fourth Edition, McGraw-Hill Book Co., Singapore, 1987.

3. Advanced Modern Engineering mathematics – Glyn James

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
2	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
3	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
4	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
5	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
Avg.	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-

24153C12P CONTROL SYSTEM 3 1 0 4

To provide sound knowledge in the basic concepts of linear control theory and design of control system.

OBJECTIVES

i. To understand the methods of representation of systems and getting their transfer function models.
ii. To provide adequate knowledge in the time response of systems and steady state error analysis.
iii. To give basic knowledge is obtaining the open loop and closed–loop frequency responses of systems.
iv. To understand the concept of stability of control system and methods of stability analysis.
v. To study the three ways of designing compensation for a control system.

UNIT I: INTRODUCTION 12

Open-loop and closed –loop systems, servomechanisms and regulator systems; Transfer function; Block diagram reduction, Signal flow graphs.

UNIT II: MATHEMATICAL MODELS OF PHYSICAL SYSTEMS 12

Mechanical systems - Translational and Rotational systems, Gear trains, Electrical systems, Thermal systems and Fluid systems.

Components of feedback control systems - Potentiometers as error sensing devices, Synch, Servomotors, Stepper motors, Tachogenerators.

UNIT III: STABILITY 12

Concept of Stability, necessary and sufficient conditions of Stability, Closed-loop systems, merits and demerits, Routh-Hurwitz Criterion.

Transient Response: Typical inputs, convolution integral, Time domain specifications, steady state errors.

State equation – Solutions – Realization – Controllability – Observability – Stability Jury's test.

UNIT IV: FREQUENCY RESPONSE 12

Definition, equivalence between transient response and frequency response, Bode plots.
Nyquist Stability Criterion: Development of criterion, gain and phase margins, m- circles and Nichol's chart.

UNIT V: ROOT LOCUS METHOD 12

Rules for sketching of root loci, Root contours.
Synthesis: Lag and Lead networks, proportional, derivative and integral controllers.
MUTLI INPUT MULTI OUTPUT (MIMO) SYSTEM:

Models of MIMO system – Matrix representation – Transfer function representation – Poles and Zeros – Decoupling – Introduction to multivariable Nyquist plot and singular values analysis – Model predictive control.

Total = 60

COURSE OUTCOMES

At the end of the course, the student should have the :

- Ability to develop various representations of system based on the knowledge of Mathematics, Science and Engineering fundamentals.
- Ability to do time domain and frequency domain analysis of various models of linear system.
- Ability to interpret characteristics of the system to develop mathematical model. Ability to design appropriate compensator for the given specifications.
- Ability to come out with solution for complex control problem. Ability to understand use of PID controller in closed loop system.

TEXT BOOK:

1. I.J.Nagrath and M.Gopal, 'Control System Engineering', Wiley Eastern Ltd., Reprint 1995.

REFERENCES:

2. M.Gopal, 'Control System Principles and Design', Tata McGraw Hill, 1998.
3. Ogatta, 'Modern Control Engineering', Tata McGraw Hill 1997.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3
CO2	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3
CO3	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3
CO4	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3
CO5	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3
Avg.	3	3	3	3	3	-	-	1	-	-	-	3	3	3	3

24153C13P- CIRCUIT THEORY 3 1 0 3

SEMESTER-1

OBJECTIVES

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

UNIT-I BASIC CIRCUITS ANALYSIS (9)

Ohm's Law – Kirchoffs laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for D.C and A.C. circuits – Phasor Diagram – Power, Power Factor and Energy.

UNIT-II NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS (9)

Network reduction: voltage and current division, source transformation – star delta conversion. Thevenins and Novton & Theorem – Superposition Theorem – Maximum power transfer theorem –Reciprocity Theorem..

UNIT-III RESONANCE AND COUPLED CIRCUITS (9)

Series and paralled resonance – their frequency response – Quality factor and Bandwidth - Self andmutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

UNIT-IV TRANSIENT RESPONSE FOR DC CIRCUITS (9hrs)

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input – Characterization of two port networks in terms of Z,Y and h parameters.

UNIT-V THREE PHASE CIRCUITS (9hrs)

Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

TOTAL 45

COURSE OUTCOMES

- Ability analyse electrical circuits
- Ability to apply circuit theorems
- Ability to analyse AC and DC Circuits

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", Tata McGraw Hill publishers,6 th edition, New Delhi, 2003.

2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Tata McGraw-Hill, New Delhi, 2001.

REFERENCES:

1. Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., New Delhi, 1996.

2. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata McGraw Hill, 2007.

3. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.

4. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2003.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	3	2	2	-	2	1	-	-	-	3	3	3	3
CO2	3	3	3	3	2	-	2	1	-	-	-	3	3	3	3
CO3	3	3	3	3	2	-	2	1	-	-	-	3	3	3	3
CO4	3	3	3	3	2	-	2	1	-	-	-	3	3	3	3
CO5	3	3	3	3	2	-	2	1	-	-	-	3	3	3	3
CO6	3	3	3	3	2	-	2	1	-	-	-	3	3	3	3
Avg.	3	3	3	2.8	2	-	2	1	-	-	-	3	3	3	3

1. **24153C14P ELECTRON DEVICES AND CIRCUITS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the structure of basic electronic devices.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and applications of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

UNIT I PN JUNCTION DEVICES 9

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diodecharacteristics- Zener Reverse characteristics – Zener as regulator

UNIT II TRANSISTORS AND THYRISTORS 9

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS 9

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series , Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

OUTCOMES: TOTAL : 45 PERIODS

Upon Completion of the course, the students will be ability to:

- Explain the structure and working operation of basic electronic devices.
- Able to identify and differentiate both active and passive elements
- Analyze the characteristics of different electronic devices such as diodes and transistors
- Choose and adapt the required components to construct an amplifier circuit.
- Employ the acquired knowledge in design and analysis of oscillators

TEXT BOOKS:

1. . David A. Bell ,"Electronic devices and circuits", Oxford University higher education, 5th edition 2008.

Sedra and smith, "Microelectronic circuits",7th Ed., Oxford University Press

REFERENCES:

1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2 2014.
2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10 Edition, 2017.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
4. Robert L.Boylestad, "Electronic devices and circuit theory", 2002.
5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
CO2	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
CO3	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
CO4	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
CO5	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
Avg.	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1

24153C15P- ELECTRICAL MACHINES – I 4 0 0 4

AIM **SEMESTER-1**

To expose the students to the concepts of electromechanical energy conversions in D.C. Machines and energy transfer in transformers and to analyze their performance.

OBJECTIVES

i. To introduce the concept of rotating machines and the principle of electromechanical energy conversion in single and multiple excited systems.
ii. To understand the generation of D.C. voltages by using different type of generators and study their performance.
iii. To study the working principles of D.C. motors and their load characteristics, starting and methods of speed control.
iv. To familiarize with the constructional details of different type of transformers, working principle and their performance.
v. To estimate the various losses taking place in D.C. machines and transformers and to study the different testing method to arrive at their performance.

UNIT I: BASIC PRINCIPLES OF ROTATING MACHINES 12

Electrical machine types – Magnetic circuits – Magnetically induced EMF and force – AC operation of magnetic circuits - core losses. Principles of Electromechanical energy conversion: Energy conversion process – Energy in magnetic system – Field energy and mechanical force – Multiply excited magnetic field systems

UNIT II: GENERATORS 12

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 12

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 12

Constructional details of core and shell type transformers – Types of windings – Principle of operation – emf equation – Transformation ratio - Equivalent circuit – Losses –Testing – Efficiency and Voltage regulation . Transformer on load– Parallel operation of single phase transformers – Auto transformer – Three phase transformers

UNIT V: TESTING OF TRANSFORMERS AND DC MACHINES 12

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 = 60

COURSE OUTCOMES

Ability to analyze the magnetic-circuits.

Ability to acquire the knowledge in constructional details of transformers. Ability to understand the concepts of electromechanical energy conversion. Ability to acquire the knowledge in working principles of DC Generator.

Ability to acquire the knowledge in working principles of DC Motor

Ability to acquire the knowledge in various losses taking place in D.C. Machines

TEXT BOOKS

1. D.P. Kothari and I.J. Nagrath, 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2002.
2. P.S. Bimbhra, 'Electrical Machinery', Khanna Publishers, 2003.

REFERENCE BOOKS

1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, 'Electric Machinery', Tata McGraw Hill publishing Company Ltd, 2003.

2. J .B.Gupta, 'Theory and Performance of Electrical Machines', S.K.Kataria and Sons, 2002.

3. K. Murugesh Kumar, 'Electric Machines', Vikas publishing house Pvt Ltd, 2002.

4. V.K.Mehta and Rohit Mehta, 'Principles of Power System', S.Chand and Company Ltd, third edition, 2003.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	1	1	1	-	-	1	-	-	-	1	3	2	2
CO2	3	3	1	1	1	-	-	1	-	-	-	1	3	1	1
CO3	3	3	1	1	1	-	-	1	-	-	-	1	3	1	1
CO4	3	3	1	1	1	-	-	1	-	-	-	1	3	3	2
CO5	3	3	1	1	1	-	-	1	-	-	-	1	3	3	2
CO6	3	3	1	1	1	-	-	1	-	-	-	1	3	3	2
Avg	3	3	1	1	1	-	-	1	-	-	-	1	3	3	3

24148S21P- NUMERICAL METHODS

3 1 0 4
Semester II

COURSE OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and 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.

UNIT I - SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **9+3hrs**

Solution of equations–Newton Raphson's method, Regula-falsi methods Solution of linear System of equations by Gaussian elimination and Gauss-Jordon methods- Iterative methods: Gauss Jacobi and Gauss-Seidel methods– Eigenvalue of a matrix by power method.

UNIT II- INTERPOLATION **9+3hrs**

Newton's forward and backward difference formulas – Central difference formula: Bessels and Stirling's formula - Lagrangian Polynomials – Divided difference method.

UNIT III- NUMERICAL DIFFERENTIATION AND INTEGRATION **9+3hrs**

Derivatives from difference tables – Divided differences and finite differences – Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Double integrals using trapezoidal and Simpson's rules.

UNIT IV - INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS **9+3hrs**

Single step methods: Taylor series method – Euler and modified Euler methods – Fourth order Runge – Kutta method for solving first and second order equations – Multistep methods: Milne's and Adam's predictor and corrector methods.

UNIT V - BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS **9+3hrs**

Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

Total no of hrs: 60hrs

COURSE OUTCOMES

- Understand the basic concepts and techniques of solving algebraic equations.

  Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.

  Apply the numerical techniques of differentiation and integration for engineering problems.

  Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

TEXT BOOKS

1. Gerald, C.F, and Wheatley, P.O, "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2002.
2. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2003.

REFERENCES BOOKS

1. Burden, R.L and Faires, T.D., "Numerical Analysis", Seventh Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.
2. Balagurusamy, E., "Numerical Methods", Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 1999

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
2	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
3	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
4	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
5	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
Avg.	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-

3.

24150S22P PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C

5 1 0 4

COURSE OBJECTIVES:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and

use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif- else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries. Read and write data from/to files in Python Programs.

TEXT BOOKS:

4. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
5. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

i. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
ii. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
iii. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021
iv. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
v. https://www.python.org/
vi. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
6	2	2	-	-	2	-	-	-	-	-	1	-	2	-	-
Avg.	2	3	3	3	2	-	-	-	-	-	2	2	3	3	-

24153C23P Electrical Machines-II L T P C 3 0 0 3

AIM:

To expose the students to the concepts of synchronous and asynchronous machines and analyze their performance.

OBJECTIVES:

To impart knowledge on

vii. Construction and performance of salient and non – salient type synchronous generators.
viii. Principle of operation and performance of synchronous motor.
ix. Construction, principle of operation and performance of induction machines.
x. Starting and speed control of three-phase induction motors.
xi. Construction, principle of operation and performance of single phase induction motors and special machines.

UNIT I: SYNCHRONOUS GENERATOR 12

Constructional details – Types of rotors – emf equation – Synchronous reactance – Armature reaction – Voltage regulation – e.m.f, m.m.f, z.p.f and A.S.A methods – Synchronizing and parallel operation – Synchronizing torque - Change of excitation and mechanical input – Two reaction theory – Determination of direct and quadrature axis synchronous reactance using slip test – Operating characteristics - Capability curves.

UNIT II: SYNCHRONOUS MOTOR 12

Principle of operation – Torque equation – Operation on infinite bus bars - V-curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed.

UNIT III: THREE PHASE INDUCTION MOTOR 12

Constructional details – Types of rotors – Principle of operation – Slip – Equivalent circuit – Slip-torque characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Separation of no load losses – Double cage rotors

UNIT IV: STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 12

Need for starting – Types of starters – Stator resistance and reactance, rotor resistance, autotransformer and star-delta starters – Speed control – Change of voltage, torque, number of poles and slip – Cascaded connection – Slip power recovery scheme.

UNIT V: SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINE 12

Constructional details of single phase induction motor – Double revolving field theory and operation – Equivalent circuit – No load and blocked rotor test — Starting methods of single-phase induction motors - Special machines - Shaded pole induction motor, reluctance motor, repulsion motor, hysteresis motor, stepper motor and AC series motor

Total = 60

COURSE OUTCOMES

- Ability to understand the construction and working principle of Synchronous Generator
- Ability to understand MMF curves and armature windings.

  Ability to acquire knowledge on Synchronous motor.
- Ability to understand the construction and working principle of Three phase Induction Motor
- Ability to understand the construction and working principle of Special Machines

  Ability to predetermine the performance characteristics of Synchronous Machines.

TEXT BOOKS

1. D.P. Kothari and I.J. Nagrath, 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2002.
2. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.*REFERENCE BOOKS*
1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, 'Electric Machinery', Tata McGraw Hill publishing Company Ltd, 2003.
2. J.B. Gupta, 'Theory and Performance of Electrical Machines', S.K.Kataria and Sons, 2002.
3. K. Murugesh Kumar, 'Electric Machines', Vikas publishing house Pvt Ltd, 2002.
4. Sheila.C.Haran, 'Synchronous, Induction and Special Machines', Scitech Publications, 2001.

REFERENCES

1. Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016.
2. M.N. Bandyo padhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2011.
3. B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers,3rd Edition, Reprint 2015.
4. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, First edition 2010.
5. Alexander S. Langsdorf, 'Theory of Alternating-Current Machinery', McGraw Hill Publications, 2001.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	2	3	3	-	-	1	-	-	-	-	3	3	2
CO2	3	3	2	3	3	-	-	1	-	-	-	-	3	3	2
CO3	3	3	2	3	3	-	-	1	-	-	-	-	3	3	2
CO4	3	3	2	3	3	-	-	1	-	-	-	-	3	3	2
CO5	3	3	1	1	2	-	-	1	-	-	-	-	3	3	2
CO6	3	3	1	1	2	-	-	1	-	-	-	-	3	3	2
Avg	3	3	1.6	2.3	2.6	-	-	1	-	-	-	-	3	3	2

24153C24P -TRANSMISSION AND DISTRIBUTION 4 0 0 4

AIM

To become familiar with the function of different components used in Transmission and Distribution levels of power systems and modeling of these components.

OBJECTIVES

i. To develop expression for computation of fundamental parameters of lines.
ii. To categorize the lines into different classes and develop equivalent circuits for these classes.
iii. To analyze the voltage distribution in insulator strings and cables and methods to improve the same.

UNIT I: INTRODUCTION 12

Structure of electric power system: Various levels such as generation, transmission and distribution; HVDC and EHV AC transmission: comparison of economics of transmission, technical performance and reliability.

Radial and ring-main distributors; interconnections; AC distribution: AC distributor with concentrated load; three-phase, four-wire distribution system; sub-mains; stepped and tapered mains.

UNITII:TRANSMISSION LINE PARAMETERS 12

Resistance, Inductance and Capacitance of single and three phase transmission lines - Stranded and Bundled conductors -Symmetrical and unsymmetrical spacing - Transposition -Application of self and mutual GMD -Skin and Proximity effect - Inductive interference with neighboring circuits.

UNIT III: MODELLING AND PERFORMANCE OF TRANSMISSION LINES 12

Classification of lines: Short line, medium line and long line; equivalent circuits, attenuation constant, phase constant, surge impedance; transmission efficiency and voltage regulation; real and reactive power flow in lines: Power-angle diagram; surge-impedance loading, loadability limits based on thermal loading, angle and voltage stability considerations; shunt and series compensation; Ferranti effect and corona loss.

UNIT IV: INSULATORS AND CABLES 12

Insulators: Types, voltage distribution in insulator string and grading, improvement of string efficiency. Underground cables: Constructional features of LT and HT cables, capacitance, dielectric stress and grading, thermal characteristics.

UNIT V: DESIGN OF TRANSMISSION LINES 12 Introduction, calculation of sag and tension .Equivalent span length and sag, Effect of ice and wind loading ,Stringing chart, sag template, conductor vibrations and vibrations dampers

TOTAL =60

COURSE OUTCOMES

To understand the importance and the functioning of transmission line parameters.

- To understand the concepts of Lines and Insulators.
- To acquire knowledge on the performance of Transmission lines.
- To acquire knowledge on Underground Cabilitys

TEXT BOOKS

1. B.R.Gupta, 'Power System Analysis and Design', S.Chand, New Delhi, 2003.
2. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, 2002.

REFERENCE BOOKS

1. Luces M.Fualkenberry ,Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 1996.
2. Hadi Saadat, 'Power System Analysis,' Tata McGraw Hill Publishing Company', 2003.
3. Central Electricity Authority (CEA), 'Guidelines for Transmission System Planning', New Delhi.
4. 'Tamil Nadu Electricity Board Handbook', 2003.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	1	-	-	-	-	-	1	-	-	-	-	3	1	1
CO2	3	2	1	1	-	1	-	2	-	-	-	-	3	2	1
CO3	3	2	1	1	-	1	-	2	-	-	-	-	3	3	1
CO4	3	2	1	1	-	1	-	2	-	-	-	-	3	3	1
CO5	3	2	1	1	-	1	-	2	-	-	-	-	3	3	1
Avg	2.8	1.8	1	1		1	-	1.8					3	2.4	1

5.

24148S31CP -PROBABILITY AND STATISTICS 3 1 0 4

(Common to Mech, Civil, EEE)

SEMESTER-III

COURSE OBJECTIVES:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in engineering problems.

UNIT I PROBABILITY AND RANDOM VARIABLE 9+3hrs

Axioms of probability - Conditional probability - Total probability - Bayes theorem - Random variable - Probability mass function - Probability density functions -Properties- Moments - Moment generating functions and their properties.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 9+3hrs

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression - Transformation of random variables - Central limit theorem.

UNIT III STANDARD DISTRIBUTIONS 9+3hrs

Binomial, Poisson, Geometric, Negative Binomial, Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties - Functions of a random variable.

UNIT IV TESTING OF HYPOTHESIS 9+3hrs

Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions - Tests for independence of attributes and Goodness of fit.

UNIT V DESIGN OF EXPERIMENTS 9+3hrs

Analysis of variance – One way classification – Complete randomized design - Two – way classification –Randomized block design - Latin square.

Note : Use of approved statistical table permitted in **Total no of hrs: 60hrs**

COURSE OUTCOMES

- Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities. Evaluation of line, surface and volume integrals using Gauss, Stokes and
- Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients

TEXT BOOKS

1. Ross. S., "A first Course in Probability", Fifth Edition, Pearson Education, Delhi 2002. (Chapters 2 to 8)
2. Johnson. R. A., "Miller & Freund's Probability and Statistics for Engineers", Sixth Edition, Pearson Education, Delhi, 2000. (Chapters 7, 8, 9, 12)

REFERENCES BOOKS

- Walpole, R. E., Myers, R. H. Myers R. S. L. and Ye. K, "Probability and Statistics for Engineers and Scientists", Seventh Edition, Pearsons Education, Delhi, 2002.
- Lipschutz. S and Schiller. J, "Schaum's outlines - Introduction to Probability and Statistics", McGraw-Hill, New Delhi, 1998.
- Gupta, S.C, and Kapur, J.N., "Fundamentals of Mathematical Statistics", Sultan Chand, Ninth Edition , New Delhi ,1996.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
2	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
3	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
4	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
5	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
Avg.	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-

Semester III

24153C32P- LINEAR INTEGRATED CIRCUITS AND APPLICATIONS

3 1 0 4

AIM

To introduce the concepts for realizing functional building blocks in ICs, fabrications & application of ICs.

OBJECTIVES

To study the IC fabrication procedure.

To study characteristics; realize circuits; design for signal analysis using To study the applications of Op-amp.

To study internal functional blocks and the applications of special ICs like circuits, regulator Circuits, ADCs.

UNIT I: IC FABRICATION 9

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 and FETs.

UNIT II: CHARACTERISTICS OF OPAMP 9

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-V/I & I/V converters ,summer, differentiator and integrator.

UNIT III: APPLICATIONS OF OPAMP 9

Instrumentation amplifier, Log and Antilog Amplifiers, 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 opamps.

UNIT IV: SPECIAL ICs 9

Functional block, characteristics & application circuits with 555 Timer Ic-566 voltage controlled oscillator Ic; 565-phase lock loop Ic ,Analog multiplier ICs.

UNIT V: APPLICATION ICs 9

IC voltage regulators –LM78XX,79XX Fixed voltage regulators - LM317, 723 Variable voltage regulators, switching regulator- SMPS- LM 380 power amplifier- ICL 8038 function generator IC.

TOTAL = 45

COURSE OUTCOMES

Ability to understand and analyse, linear and digital electronic circuits.

TEXT BOOKS

2. David A.Bell, 'Op-amp & Linear ICs', Oxford, 2013.
3. D.Roy Choudhary, Sheil B.Jani, 'Linear Integrated Circuits', II edition, New Age, 2003.
4. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2003 / PHI. 2000.

REFERENCE BOOKS

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',Tata McGraw Hill, 2003.
4. Robert F.Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', PHI Learning, 6th edition,2012.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	2	3	2	2	-	-	1	-	-	-	1	3	2	1
CO2	2	2	3	2	2	-	-	1	-	-	-	1	3	2	1
CO3	2	2	3	2	2	-	-	1	-	-	-	1	3	2	1
CO4	2	2	3	2	2	-	-	1	-	-	-	1	3	2	1
CO5	2	2	3	2	2	-	-	1	-	-	-	1	3	2	1
Avg	2	2	3	2	2	-	-	1	-	-	-	1	3	2	1

SEMESTER-III

24153C33P - POWER ELECTRONICS 4 0 0 4

AIM:

To understand the various applications of electronic devices for conversion, control and conditioning of the electrical power.

OBJECTIVES:

- To get an overview of different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and Matrix converters.

UNIT I- POWER SEMI-CONDUCTOR DEVICES : 12

Overview of switching devices – Driver and snubber circuit of SCR TRIAC, GTO, GBT, MOSFET – Computer simulation of PE circuits.

UNIT II-PHASE CONTROLLED CONVERTERS

12

2 pulse / 3 pulse and 6 pulse converters – Effect of source inductance – performance parameters – Reactive power control of converters – Dual converters.

UNIT III -DC TO DC CONVERTERS 12

Stepdown and stepup chopper – Forced commutation techniques – Time ratio control and current limit control – Switching mode regulators Buck, Boost, Buck-Boost – concept of resonant switching.

UNIT IV- INVERTERS 12

Single phase and three phase [120& 180mode] inverters – PWM techniques –Sinusoidal PWM, Modified sinusoidal PWM and multiple PWM – Voltage and harmonic control – Series resonant inverter – current source inverter.

UNIT V- AC TO AC CONVERTERS12

Single phase AC voltage controllers – Multistage sequence control – single phase andthree phase cycloconverters – power factor control – Matrix converters.

L: 45 T: 15 TOTAL: 60 PERIODS

COURSE OUTCOMES

- Ability to analyse AC-AC and DC-DC and DC-AC converters.
- Ability to choose the converters for real time applications.

TEXT BOOKS:

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, 3rd Edition, New Delhi, 2004.
2. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", John wiley and Sons, 3rd Edition, 2006.

REFERENCES:

1. Cyril.W.Lander, "Power Electronics", McGraw Hill International, Third Edition, 1993.
2. P.S.Bimbra "Power Electronics", Khanna Publishers, third Edition 2003.
3. Philip T.Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	2	1	-	-	3	3	3	3	3
CO2	3	3	3	3	-	-		1	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	2	1	-	-	2	-	3	3	3
CO4	3	3	3	3	-	-	1	1	-	-	2	3	3	3	3
CO5	3	3	3	3	-	-	1	1	-	-	2	3	3	3	3
Avg.	3	3	3	3	-	-	1.5	1	-	-	2.25	3	3	3	3

24153C34P-MEASUREMENTS AND INSTRUMENTATION

4 0 0 4

Semester III

AIM

To provide adequate knowledge in electrical instruments and measurements techniques.

OBJECTIVES

To make the student have a clear knowledge of the basic laws governing the operation of the instruments, relevant circuits and their working.

i. Introduction to general instrument system, error, calibration etc.
ii. Emphasis is laid on analog and digital techniques used to measure voltage, current, energy and power etc.
iii. To have an adequate knowledge of comparison methods of measurement.
iv. Elaborate discussion about storage & display devices.
v. Exposure to various transducers and data acquisition system.

UNIT I: INTRODUCTION **10**

Functional elements of an Instrument -Static and Dynamic characteristics -Errors in measurement -Statistical evaluation of measurement data -Standard and Calibration.

UNIT II: ELECTRICAL AND ELECTRONICS INSTRUMENTS **12**

Construction and principle of operation of moving coil, moving Iron, Principle and types analog and digital ammeters and voltmeters -Single and three phase Wattmeter and Energy meter - magnetic measurements - -Instruments for measurement of frequency and phase.

UNIT III: SIGNAL CONDITIONING CIRCUITS **12**

Bridge circuits – Differential and Instrumentation amplifiers -Filter circuits - V/f and f/V converters – P/I and I/P converters – S/H Circuit, A/D and D/A converters -Multiplexing and De-multiplexing -Data acquisition systems –Grounding techniques.

UNIT IV: STORAGE AND DISPLAY DEVICES **12**

Magnetic disc and Tape Recorders -Digital plotters and printers -CRT displays -Digital CRO – LED, LCD and Dot matrix displays.

UNIT V: TRANSDUCERS **14**

Classification of Transducers -Selection of Transducers –Resistive, Capacitive and Inductive Transducers -Piezo electric Transducers -Transducers for measurement of

displacement, temperature, level, flows, pressure, velocity, acceleration, torque, speed, viscosity and moisture.

Total = 60

COURSE OUTCOMES

To acquire knowledge on Basic functional elements of instrumentation

To understand the concepts of Fundamentals of electrical and electronic instruments

Ability to compare between various measurement techniques

To acquire knowledge on Various storage and display devices

To understand the concepts Various transducers and the data acquisition systems

Ability to model and analyze electrical and electronic Instruments and understand the operational features of display Devices and Data Acquisition System.

TEXT BOOKS

1. E.O. Doebelin, 'Measurement Systems – Application and Design', Tata McGraw Hill publishing company, 2003.
2. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2004.

REFERENCE BOOKS

1. A.J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 1997.
2. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2003.
3. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, 1995.
4. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.
5. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria & Sons, Delhi, 2003.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	3	-	3	2	-	2	-	-	-	3	3	3	3
CO2	3	2	3	2	-	-	-		-	3	-	3	3	3	3
CO3	3	2	3	-	3	2	-		-	-	-	3	3	3	3
CO4	3	2	3	-	-	-	-	2	-	-	-	-	3	3	3
CO5	3	2	3	2	3	-	-		-	3	-	3	3	3	3
Avg	3	2	3	2	3	2	-	2	-	3	-	3	3	3	3

24153L35P- DC AND AC ELECTRICAL MACHINES LABORATORY

0 0 3 2

Semester III

OBJECTIVES:

To impart hands on experience in verification of circuit laws and theorems, measurement of circuit parameters, study of circuit characteristics and simulation of time response.

To expose the students to the basic operation of electrical machines and help them to develop experimental skills.

LIST OF EXPERIMENTS

1. Open circuit characteristics of D.C. shunt generator.
2. Load characteristics of D.C. shunt generator.
3. Load test on D.C. shunt and Compound Motor.
4. Load test on D.C. series motor.
5. Swinburne's test and speed control of D.C. shunt motor
6. Hopkinson's test on D.C. motor generation set.
7. Load test on single phase and three phase transformer
8. open circuit and short circuit tests on single phase and three phase transformer (Determination of equivalent circuit parameters).
9. Load test on single phase induction motor.
10. No load and blocked rotor tests on three phase induction motor (Determination of equivalent circuit parameters)
11. Load test on Three phase induction motor.
12. Study of Starters **TOTAL: 45**

COURSE OUTCOMES

At the end of the course, the student should have the :

Ability to conduct performance tests on DC and AC machines

Ability to understand and analyze EMF and MMF methods

Ability to analyze the characteristics of V and Inverted V curves

Ability to understand the importance of Synchronous machines

Ability to understand the importance of Induction Machines

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. DC Shunt Motor with Loading Arrangement – 3 nos
2. Single Phase Transformer – 4 nos
3. DC Series Motor with Loading Arrangement – 1 No.

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

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	1	1	-	-	-	-	1	-	-	-	3	1	1
CO2	3	3	1	1	-	-	-	-	1	-	-	-	3	3	2
CO3	3	3	1	1	-	-	-	-	1	-	-	-	3	3	2
CO4	3	3	1	1	-	-	-	-	1	-	-	-	2	3	2
CO5	3	3	1	1	-	-	-	-	1	-	-	-	2	3	2
CO6	3	3	1	1	-	-	-	-	1	-	-	-	2	3	1
Avg	3	3	1	1	-	-	-	-	1	-	-	-	2.5	2.6	1.6

SEMESTER-IV

24153C41P- PROTECTION AND SWITCHGEAR

4 0 0 4

AIM

To expose the students to the various faults in power system and learn the various methods of protection scheme.
To understand the current interruption in Power System and study the various switchgears.

OBJECTIVES

i. Discussion on various earthling practices usage of symmetrical components to estimate fault current and fault MVA.
ii. Study of Relays & Study of protection scheme, solid state relays.
iii. To understand instrument transformer and accuracy.
iv. To understand the method of circuit breaking various arc theories Arcing phenomena – capacitive and inductive breaking.
v. Types of circuit breakers.

UNIT I: INTRODUCTION **12**

Principles and need for protective schemes – nature and causes of faults – types of faults – fault current calculation using symmetrical components – Power system earthing - Zones of protection and essential qualities of protection – Protection scheme.

UNIT II: OPERATING PRINCIPLES AND RELAY CONSTRUCTIONS **12**

Need for protection – essential qualities of protective relays – Electromagnetic relays, Induction relays – Over current relays - Directional, Distance, Differential and negative sequence relays. Static relays

UNIT III: APPARATUS PROTECTION **12**

Apparatus protection transformer, generator, motor, protection of bus bars, transmission lines – CTs and PTs and their applications in protection schemes.

UNIT IV: THEORY OF CIRCUIT INTERRUPTION **12**

Physics of arc phenomena and arc interruption. Restricting voltage & Recovery voltage, rate of rise of recovery voltage, resistance switching, current chopping, and interruption of capacitive current – DC circuit breaking.

UNIT V: CIRCUIT BREAKERS **12**

Types of Circuit Breakers – Air blast, Air break, oil SF_6 and Vacuum circuit breakers – comparative merits of different circuit breakers – Testing of circuit breakers

COURSE OUTCOMES

- Ability to understand and analyze Electromagnetic and Static Relays.
- Ability to suggest suitability circuit breaker.
- Ability to find the causes of abnormal operating conditions of the apparatus and system.
- Ability to analyze the characteristics and functions of relays and protection schemes. Ability to study about the apparatus protection, static and numerical relays.
- Ability to acquire knowledge on functioning of circuit breaker.

TEXT BOOKS

1. B. Ravindranath, and N. Chander, 'Power System Protection & Switchgear', Wiley Eastern Ltd., 1977.

REFERENCE BOOKS

1. Sunil S. Rao, 'Switchgear and Protection', Khanna publishers, New Delhi, 1986 .
2. C.L. Wadhwa, 'Electrical Power Systems', Newage International (P) Ltd., 2000.
3. M.L. Soni, P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, 'A Text Book on Power System Engineering', Dhanpat Rai & Co., 1998.
4. Badri Ram, Vishwakarma, 'Power System Protection and Switchgear', Tata McGraw hill, 2001.
5. Y.G. Paithankar and S.R. Bhide, 'Fundamentals of Power System Protection', Prentice Hall of India Pvt. Ltd., New Delhi – 110001, 2003.

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MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	2	1	1	1	1	2	-	3	1	-
CO2	3	1	1	2	1	2	1	1	1	1	2	-	3	1	-
CO3	3	1	1	2	1	2	1	1	1	1	2	-	3	2	-
CO4	3	1	1	2	1	2	1	1	1	1	2	-	3	2	1
CO5	3	1	1	2	2	2	1	1	1	1	2	-	3	1	1
Avg.	3	1	1	2	1.2	2	1	1	1	1	2	-	3	1.4	1

24153C42P -HIGH VOLTAGE DC TRANSMISSION

3 1 0 4

Semester IV

AIM:

To learn the HVDC modelling and control strategy.

OBJECTIVES:

- To study the performance of converters and modeling of DC line with controllers.
- To study about converter harmonics and its mitigation using active and passive filters.

UNIT I- DC POWER TRANSMISSION TECHNOLOGY 9

Introduction-comparison of AC and DC transmission application of DC transmission – Description of DC transmission system planning for HVDC transmission-modern trends In DC transmission.

UNIT II- ANALYSIS OF HVDC CONVERTERS 9

Pulse number, choice of converter configuration-simplified analysis of Graetz circuit converter bridge characteristics – characteristics of a twelve pulse converter-detailed analysis of converters.

UNIT III- CONVERTER AND HVDC SYSTEM CONTROL 9

General 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-telecommunication requirements.

UNIT IV -HARMONICS AND FILTERS 9

Introduction-generation of harmonics-design of AC filters-DC filters-carrier frequency and RI noise.

UNIT V -SIMULATION OF HVDC SYSTEMS 9

Introduction-system simulation: Philosophy and tools-HVDC system simulation-modeling of HVDC systems for digital dynamic simulation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- Ability to understand Generation and measurement of high voltage. Ability to understand High voltage testing.
- Ability to understand various types of over voltages in power system. Ability to measure over voltages.
- Ability to test power apparatus and insulation coordination

TEXT BOOKS:

1. Padiyar, K.R., HVDC power transmission system, Wiley Eastern Limited, New Delhi 1990.First edition.
2. P.Kundur, 'Power System Stability and Control', Tata McGraw Hill Publishing Company Ltd., USA, 1994.
3. Arrillaga, J., High Voltage direct current transmission, Peter Pregrinus, London, 1983.

REFERENCES:

1. Edward Wilson Kimbark, Direct Current Transmission, Vol. I, Wiley interscience, New York, London, Sydney, 1971.
2. Rakosh Das Begamudre, Extra high voltage AC transmission engineering New

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	1	3	1	-	-	-	-	-	-	-	2	3	3
CO2	2	3	1	2	3	-	-	-	-	-	-	-	2	3	3
CO3	2	3	1	3	1	-	-	-	-	-	-	-	2	3	3
CO4	3	3	1	2	3	-	-	-	-	-	-	-	2	3	3
CO5	3	3	1	3	1	-	-	-	-	-	-	-	2	3	3
Avg	2.6	3	1	2.6	1.8	-	-	-	-	-	-	-	2	3	3

24153C43P- SOLID STATE DRIVES

3 1 0 4

Semester IV

AIM

To study and understand the operation of electric drives controlled from a power electronic converter and to introduce the design concepts of controllers.

OBJECTIVES

i. To understand the stable steady-state operation and transient dynamics of a motor-load system.
ii. To study and analyze the operation of the converter / chopper fed dc drive and to solve simple problems.
iii. To study and understand the operation of both classical and modern induction motor drives.
iv. To understand the differences between synchronous motor drive and induction motor drive and to learn the basics of permanent magnet synchronous motor drives.
v. To analyze and design the current and speed controllers for a closed loop solid-state d.c motor drive.

UNIT I DRIVE CHARACTERISTICS **9**

Equations governing motor load dynamics - Equilibrium operating point and its steady state stability - Mathematical condition for steady state stability and problems - Multi quadrant dynamics in the speed torque plane - Basics of regenerative braking - Typical load torque characteristics - Acceleration, deceleration, starting and stopping**.**

UNIT II DC MOTOR DRIVE **9**

Steady state analysis of the single and three phase fully controlled converter fed separately excited D.C motor drive: Continuous and discontinuous conduction mode - Chopper fed D.C drive: Time ratio control and current limit control - Operation of four quadrant chopper.

UNIT III STATOR CONTROLLED INDUCTION MOTOR DRIVES **9**

Variable terminal voltage control – Variable frequency control – V/f control - AC voltage controllers – Four-quadrant control and closed loop operation - Frequency controlled drives- VSI and CSI fed drives – closed loop control.

UNIT IV ROTOR CONTROLLED INDUCTION MOTOR DRIVES **9**

Rotor resistance control – slip power recovery schemes - sub synchronous and super synchronous operations – closed loop control – Braking in induction motors.

UNIT V- SYNCHRONOUS MOTOR DRIVES **9**

Wound field cylindrical rotor motor – operation from constant voltage and frequency source – operation from current source – operation from constant frequency – Brushless excitation – Permanent magnet synchronous motor.

Self-controlled Synchronous motor drives – Brushless dc and ac motor drives – CSI with load commutation – Cycloconverter with load commutation.

TOTAL = 45

COURSE OUTCOMES

- Ability to understand and suggest a converter for solid state drive.
- Ability to select suitability drive for the given application.
- To study about the steady state operation and
- TO analyze the operation of the converter/chopper

  fed drive.
- Ability to analyze the operation and performance of AC motor drives.
- Ability to analyze and design the current and speed controllers for a closed loop solid

TEXT BOOKS

1. R. Krishnan, 'Electric Motor & Drives: Modelling, Analysis and Control', Prentice Hall of India, 2001.
2. Bimal K. Bose. 'Modern Power Electronics and AC Drives', Pearson Education, 2002.

REFERENCE BOOKS

1. G.K. Dubey, 'Power Semi-conductor Controlled Drives', Prentice Hall of India, 1989.
2. Vedam Subrahmanyam, "Electric drives concepts and applications", TMH Pub. Co.Ltd., 1994.
3. Murphy, J.M.D and Turnbull.F.G. , "Thyristor control of AC Motors", Pergamon Press, 1988.
4. Sen. P.C., "Thyristor D.C. Drives", John Wiley and Sons, 1981.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	-	-	1	-	-	-	2	3	3	2
CO2	3	2	2	3	3	-	-	1	-	-	-	2	3	3	2
CO3	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
CO4	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
CO5	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
CO6	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
Avg	3	2	2	3	3	-	-	1	-	-	-	2	3	3	2

24153E44AP ENERGY MANAGEMENT AND AUDITING

3 0 0 3

OBJECTIVES: To impart knowledge about the following topics:

- To impact concepts behind economic analysis and Load management.
- Energy management on various electrical equipments and metering.
- Concept of lighting systems and cogeneration.

UNIT I INTRODUCTION 9

Basics of Energy – Need for energy management – Energy accounting - Energy monitoring, targeting and reporting - Energy audit process.

UNIT II ENERGY MANAGEMENT FOR MOTORS AND COGENERATION 9

Energy management for electric motors – Transformer and reactors - Capacitors and synchronous machines, energy management by cogeneration – Forms of cogeneration – Feasibility of cogeneration – Electrical interconnection.

UNIT III LIGHTING SYSTEMS 9

Energy management in lighting systems – Task and the working space - Light sources – Ballasts – Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards.

UNIT IV METERING FOR ENERGY MANAGEMENT 9

Metering for energy management – Units of measure - Utility meters – Demand meters – Paralleling of current transformers – Instrument transformer burdens – Multi tasking solid state meters, metering location vs requirements, metering techniques and practical examples.

UNIT V ECONOMIC ANALYSIS AND MODELS 9

Economic analysis – Economic models - Time value of money - Utility rate structures – Cost of electricity – Loss evaluation, load management – Demand control techniques – Utility monitoring and control system – HVAC and energy management – Economic justification.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand the basics of Energy audit process.
- Ability to understand the basics of energy management by cogeneration
- Ability to acquire knowledge on Energy management in lighting systems
- Ability to impact concepts behind economic analysis and Load management.
- Ability to understand the importance of Energy management on various electrical equipment and metering.
- Ability to acquire knowledge on HVAC.

TEXT BOOKS:

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
2. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,.Logman Scientific & Technical, ISBN-0-582-03184 , 1990.

REFERENCES

1. Reay D.A, Industrial Energy Conservation, 1st edition, Pergamon Press, 1977.
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 196.
3. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
4. Electricity in buildings good practice guide, McGraw-Hill Education, 2016.
5. National Productivity Council Guide Books

List of Open Source Software/ Learning website:

1. http://lab.fs.uni-lj.si/kes/erasmus/Energy%20Management%20Handbook.pdf
2. https://www.sciencedirect.com/science/article/pii/S2212827114004491
3. https://mppolytechnic.ac.in/mp-staff/notes_upload_photo/CS595EnergyEfficiencyinElectricalUtilities-5391.pdf
4. http://knowledgeplatform.in/wp-content/uploads/2017/03/1.3-Energy-management-Audit.pdf

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	-	-	-	1	-	-		2	3	2	3
CO2	3	-	-	-	-	-	2	1	3	-	1	2	3	2	3
CO3	3	-	1	2	3	-	-	1		-	-	2	3	2	3
CO4	3	3	-	-	-	-	-	1	3	-	-	2	3	2	3
CO5	3	-	1	2	-	-	-	1		-	2	2	3	2	3
Avg	3	2.5	1	2	3	-	2	1	3	-	1.5	2	3	2	3

24153L45P- CONTROL AND INSTRUMENTATION LABORATORY

0 0 3 2

Semester IV

AIM

To provide knowledge on analysis and design of control and instrumentation

LIST OF EXPERIMENTS

CONTROLSYSTEMS:

1. P, PI and PID controllers
2. Stability Analysis
3. Modeling of Systems – Machines, Sensors and Transducers
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.

INSTRUMENTATION:

8. Bridge Networks –AC and DC Bridges
9. Dynamics of Sensors/Transducers

a. Temperature
b. Pressure
c. Displacement
d. Optical
e. Strain f. Flow

10. Power and Energy Measurement
11. Signal Conditioning

a. Instrumentation Amplifier
b. Analog – Digital and Digital –Analog converters (ADC and DACs)

12. Process Simulation. **P = 45**

Total = 45

COURSE OUTCOMES

Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CONTROLSYSTEMS:

1. PID kit – 1 No.

DSO – 1 No.
CRO Probe – 2 nos
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.

APPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	3
CO2	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	3
CO3	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	3
CO4	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	3
CO5	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	3
Avg	3	3	3	3	3	-	-	1.5	-	-	-	2	3	3	3

24153C51P-POWER SYSTEM ANALYSIS

3 1 0 4
Semester V

AIM

To become familiar with different aspects of modeling of components and system and different methods of analysis of power system planning and operation.

OBJECTIVES

i. To model steady-state operation of large-scale power systems and to solve the power flow problems using efficient numerical methods suitable for computer simulation.
ii. To model and analyse power systems under abnormal (fault) conditions.
iii. To model and analyse the dynamics of power system for small-signal and large signal disturbances and o design the systems for enhancing stability.

UNIT I- THE POWER SYSTEM AN OVER VIEW AND MODELLING 12

Moder n Power System - Basic Components of a power system - Per Phase Analysis Generator model - Transformer model - line model. The per unit system -Change of base.

UNIT II- POWER FLOW ANALYSIS 12

Introduction - Bus Classification - Bus admittance matrix - Solution of non-linear Algebraic equations - Gauss seidal method - Newton raphson method - Fast decoupled method - Flow charts and comparison of the three methods.

UNIT III-FAULT ANALYSIS-BALANCED FAULT 12

Introduction – Balanced three phase fault – short circuit capacity – systematic fault analysis using bus impedance matrix – algorithm for formation of he bus impedance matrix.

UNIT IV-FAULT ANALYSIS – SYMMETRICAL COMPONENTS AND UNBALANCED FAULT 12

Introduction – Fundamentals of symmetrical components – sequence impedances – sequence networks – single line to ground fault – line fault - Double line to ground fault – Unbalanced fault analysis using bus impedance matrix.

UNIT V-POWER SYSTEM STABILITY 12

Dynamics of a Synchronous machine – Swing equation and Power angle equation – Steady state Stability and Transient state Stability - Equal area criterion – Cearing angle and time- Numerical solution of Swing equation for single machine

Total = 60 Hrs

COURSE OUTCOMES

Ability to model the power system under steady state operating condition

Ability to understand and apply iterative techniques for power flow analysis

Ability to model and carry out short circuit studies on power system

Ability to model and analyze stability problems in power system

- Ability to acquire knowledge on Fault analysis.
- Ability to model and understand various power system components and carry out power flow, short circuit and stability studies

TEXT BOOKS:

1. Hadi Saadat "Power system analysis", Tata McGraw Hill Publishing Company, New Delhi, 2002 (Unit I, II, III, IV)
2. P.Kundur, "Power System Stability and Control", Tata McGraw Hill Publishing Company, New Delhi, 1994 (Unit V)

REFERENCE BOOKS:

1. I.J.Nagrath and D.P.Kothari, 'Modern Power System Analysis', Tata McGraw-Hill publishing company, New Delhi, 1990.
2. M.A. Pai, 'Computer Techniques in power system Analysis', Tata McGraw – Hill publishing company, New Delhi, 2003.
3. John J. Grainger and Stevenson Jr. W.D., 'Power System Analysis', McGraw Hill International Edition, 1994

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MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	1	-	-	-	2	3	3	3
CO2	3	2	1	1	-	1	-	2	-	2	-	2	3	3	3
CO3	3	2	1	1	-	1	-	2	-	2	-	2	3	3	3
CO4	3	2	1	1	-	1	-	2	-	2	-	2	3	1	2.33
CO5	2	1	-	-	-	-	-	1	-	2	-	2	3	3	3
Avg.	2	1.6	1	1	-	1	-	1.6	-	2	-	2	3	2.2	2.86

24153C52P - POWER QUALITY 3 1 0 4

Semester V

COURSE OBJECTIVES:

- To learn the basic definitions in Power Quality.
- To study the power quality issues in Single Phase and Three Phase Systems.
- To understand the principles of Power System Harmonics.
- To know the way to use DSTATCOM for Harmonic Mitigation.

To learn the concepts related with Series Compensation.

UNIT I INTRODUCTION TO POWER QUALITY 3

Terms and definitions: Overloading, under voltage, sustained interruption; sags and swells; waveform distortion, Total Harmonic Distortion (THD), Computer Business Equipment Manufacturers Associations (CBEMA) curve.

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 7

Sources of sags and interruptions, estimating voltage sag performance, motor starting sags, estimating the sag severity, mitigation of voltage sags, active series compensators, static transfer switches and fast transfer switches.

UNIT III OVER VOLTAGES 10

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.

UNIT IV HARMONICS 12

Harmonic distortion: Voltage and current distortion, harmonic indices, harmonic sources from commercial and industrial loads, locating harmonic sources; power system response characteristics, resonance, harmonic distortion evaluation, devices for controlling harmonic distortion, passive filters, active filters, IEEE and IEC standards.

UNIT V POWER QUALITY MONITORING 17

Monitoring considerations: Power line disturbance analyzer, per quality measurement equipment, harmonic/spectrum analyzer, flicker meters, disturbance analyzer, applications of expert system for power quality monitoring.

L=45 Total=45

COURSE OUTCOMES

- Ability to understand and analyze power system operation, stability, control and protection.
- The students able to understand the over voltage protection & analysis tools used for analyzing the transients.
- They are fully trained in designing and evaluating the devices of harmonic distortion.

REFERENCE BOOKS

1. Roger.C.Dugan, Mark.F.McGranagham, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality' McGraw Hill, 2003.
2. PSCAD User Manual.

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MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
CO2	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
CO3	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
CO4	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
CO5	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
Avg	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3

24153C53P- SPECIAL ELECTRICAL MACHINES **4 0 0 4**

Semester V

AIM

To expose the students to the construction, principle of operation and performance of special electrical machines as an extension to the study of basic electrical machines.

OBJECTIVES

To impart knowledge on

i. Construction, principle of operation and performance of synchronous reluctance motors.

ii. Construction, principle of operation and performance of stepping motors.

iii. Construction, principle of operation and performance of switched reluctance motors.

iv. Construction, principle of operation and performance of permanent magnet brushless D.C. motors.

v. Construction, principle of operation and performance of permanent magnet synchronous motors.

UNIT I-SYNCHRONOUS RELUCTANCE MOTORS **9**

Constructional features – types – axial and radial air gap motors – operating principle – reluctance – phasor diagram - characteristics – Vernier motor.

UNIT II -STEPPING MOTORS **9**

Constructional features – principle of operation – variable reluctance motor – Hybrid motor – single and Multi stack configurations – theory of torque predictions – linear and non-linear analysis – characteristics – drive circuits.

UNIT III-SWITCHED RELUCTANCE MOTORS **9**

Constructional features – principle of operation – torque prediction – power controllers – Nonlinear analysis – Microprocessor based control - characteristics – computer control.

UNIT IV-PERMANENT MAGNET BRUSHLESS D.C. MOTORS **9**

Principle of operation – types – magnetic circuit analysis – EMF and Torque equations – Power Controllers – Motor characteristics and control.

UNIT V-PERMANENT MAGNET SYNCHRONOUS MOTORS **9**

Principle of operation – EMF and torque equations – reactance – phasor diagram – power controllers - converter - volt-ampere requirements – torque speed characteristics - microprocessor based control.

L=45 Total=45

COURSE OUTCOMES

Ability to analyze and design controllers for special Electrical Machines.

- Ability to acquire the knowledge on construction and operation of stepper motor.
- Ability to acquire the knowledge on construction and operation of stepper

switched reluctance motors.

- Ability to construction, principle of operation, switched reluctance motors.

- Ability to acquire the knowledge on construction and operation of permanent magnet brushless D.C. motors.
- Ability to acquire the knowledge on construction and operation of permanent magnet synchronous motors.

TEXT BOOKS

1. Miller, T.J.E., 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 2289.
2. Aearnley, P.P., 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus, London, 1982.

REFERENCES

1. Kenjo, T., 'Stepping Motors and their Microprocessor Controls', Clarendon Press London, 1984.
2. Kenjo, T., and Nagamori, S., 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.

List of Open Source Software/ Learning website:

1) https://archive.nptel.ac.in/courses/108/104/108104140/
2) https://www.embedded.com/mcus-or-dsps-which-is-in-motor-control/
3) https://www.e3s- conferences.org/articles/e3sconf/pdf/2019/13/e3sconf_SeFet2019_01004.pdf
4) https://www.electronics-tutorials.ws/blog/pulse-width-modulation.html
5) http://kaliasgoldmedal.yolasite.com/resources/SEM/SRM.pdf

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	1	-	-	-	-	-	-	-	2	1	2
CO2	2	1	3	2	1	-	-	-	-	-	-	-	2	1	2
CO3	3	2	3	3	3	-	-	-	-	-	-	-	1	3	3
CO4	3	2	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	2	1	2	1	-	-	-	1	-	-	-	2	2	3
Avg	2.4	1.6	2.4	2.4	1.8	-	-	-	1	-	-	-	2	2	2.6

3.

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24153E54FP -SUSTAINABLE AND ENVIRONMENTAL FRIENDLY HV INSULATION SYSTEM

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To Know about the products related with sustainable applicaton.
- To learn about Green Gaseous, liquid solid insulators.
- To understand the standards for green insulation systems.

UNIT I SUSTAINABLE AND ENVIRONMENTAL ENERGY AND PRODUCTS 9

Carbon print, global warming potential, environment requirement for any product and system.

UNIT II ALTERNATE GREEN GASEOUS INSULATORS 9

SF6 gas and its hazardous environmental effects, alternate gases, gaseous mixtures and other sources and it's properties.

UNIT III ALTERNATE GREEN LIQUID INSULATORS 9

hazardous effects of existing liquid dielectric materials (such as organic oil), alternate sources of environmental friendly liquid such as ester oil, vegetable oils dielectric and it's properties.

UNIT IV ALTERNATE GREEN SOLID INSULATORS 9

hazardous effects of existing solid dielectric materials, alternate sources of environmental friendly solid dielectric and its properties.

UNIT V EVOLVING STANDARDS FOR GREEN INSULATION SYSTEMS 9

Requirements, evolving standards of management, testing, usage and disposal of alternate insulation systems, Major applications and standards

TOTAL : 45

PERIODSREFERENCES:

https://www.iso.org/standard/79064.html
https://www.ictfootprint.eu/en/iec-tr-627252013-factsheet
https://www.iec.ch/dyn/www/f?p=103:7:0::::FSP_ORG_ID,FSP_LANG_ID:1275,25
https://www.iec.ch/ords/f?p=103:41:628762356646470:::FSP_ORG_ID,FSP_LANG_ID:3237, 25
https://www.iec.ch/dyn/www/f?p=103:7:0::::FSP_ORG_ID,FSP_LANG_ID:1299,25
https://www.iec.ch/sdgs/sdg13
http://highperformanceinsulation.eu/wp- content/uploads/ 2016/08/ sustainability_a_guide.pdf

COURSE OUTCOMES:

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

CO1: Know about sustainable and environmental energy and products.
CO2: Describe the alternate green gaseous insulators.
CO3: Describe the alternate green liquid insulators
CO4: Describe the alternate green solid insulators
CO5: Elaborate the standards for Green insulation systems.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	2	2	-	3	-	3	3	--	-
CO2	3	3	3	3	-	-	2	2	-	3	-	3	3	3	3
CO3	3				-	-			-		-		3	3	3
CO4	3	3	3	3	-	-	2	2	-	2	-	1	3	3	3
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	3	3
CO6	3	3	3	3	3	-	2	2	-	3	-	2	3	3	3
Avg	3	3	3	3	3	-	2	2	-	2.75	-	2.25	3	3	3

24153L55P **Power Electronics and Drives Lab** 0 0 3 2

AIM

To study the characteristics of switching devices and its applications in rectifier inverter, chopper and resonant converter.

1. Study Of V-I Characteristics Of An SCR.
2. Study Of V-I Characteristics Of A TRIAC.
3. Study Of Different Trigerring Circuits For Thyristor.
4. Study Of Uni- Junction Transistor (UJT) Trigerring Circuit.
5. Study Of A Firing Circuit Suitable For Single Phase Half Controlled Convertor.
6. Simulation On the Single Phase Ac-Dc Uncontrolled Convertor with & without the source Inductance.
7. Simulation Of A Single Phase Ac To Controlled Dc Convertor with & without the source Inductance.
8. Single Phase Half Controlled Bridge Convertor With Two Thyristors & Two Diodes.
9. Single Phase Fully Controlled Bridge Convertor Using Four Thyristors.
10. Pspice or MATH LAB Simulation Of Dc to Dc Step Down Chopper.
11. Pspice or MATH LAB Simulation Of Single Phase Controller with R-L Load.
12. Pspice or MATH LAB Simulation Of PWM Bridge Invertor Of R-L Load Using MOSFET.

COURSE OUTCOMES

- Ability to practice and understand converter and inverter circuits and apply software for engineering problems.
- Ability to analyze about AC to DC converter circuits.
  Ability to analyze about DC to AC circuits.
- Ability to acquire knowledge on AC to AC converters
  Ability to acquire knowledge on simulation software.

24153C61P- UTILIZATION OF ELECTRICAL ENERGY

3 1 0 4

Semester VI

AIM

To plan and design using basic principles and handbooks

To select equipment, processes and components in different situations.

OBJECTIVES

i. To ensure that the knowledge acquired is applied in various fields as per his job requirements.

ii. To orient the subject matter in the proper direction, visits to industrial establishments are recommended in order to familiarize with the new developments in different areas.

UNIT I ELECTRIC LIGHTING 12

Production of light – Definition of terms – Lighting calculations – Types of lamps – Interior and Exterior illumination systems – Lighting schemes – Design of Lighting schemes – Factory lighting – Flood lighting – Energy saving measures.

UNIT II ELECTRIC HEATING 12

Resistance heating – Induction heating – Dielectric heating – Arc furnace – Control equipment, efficiency, and losses – Energy conservation in Arc Furnace Industry.

UNIT III ELECTRIC WELDING 12

Welding equipment – Characteristics of carbon and metallic arc welding – Butt welding – Spot welding – Energy conservation in welding.

UNIT IV ELECTRIC VEHICLE 12

Traction: System of track electrification, train movement and energy consumption (speed time curves, crest speed, average speed and schedule speed) rective effort, factors affecting energy consumption (dead weight, acceleration weight and adhesion weight) starting and braking of traction motors, protective devices

UNIT V ELECTRO CHEMICAL PROCESS 12

Electrolysis – Electroplating – Electro deposition – Extraction of metals – Current, efficiency – Batteries – Types – Charging methods.

Total = 60

COURSE OUTCOMES

T o understand the main aspects of generation, utilization and conservation.

To identify an appropriate method of heating for any particular industrial application.

To evaluate domestic wiring connection and debug any faults occurred.

To construct an electric connection for any domestic appliance like refrigerator as well as to design a battery charging circuit for a specific household application.

Text Books:

1. Tripathy,S.C., "Electric Energy Utilization & Conservation" – Tata McGraw Hill Publishing Company.
2. Uppal,S.L., "Electric Power", Khanna Publishers.
3. Soni,M.L., P.V.Gupta & Bhatnagar , "A course in Electric Power", Dhanpat Rai & Sons.

Reference Books:

1. Partab,H., "Art & Science Utilization of Electrical Energy" – Dhanpat Rai & Sons.
2. Wadhwa,C.L., "Generation, Utilization & Distribution" - Wilsey Eastern Ltd.
3. Wadha C L - Utilization of Electric Power; New Age International
4. Suryanarayana . N.V., "Utilization of Electric Power" - Wilsey Eastern Ltd.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	2	1	-	1	-	1.5	-	-	-	-	3	-	-
CO2	2	1	3	-	-	-	-	1.5	-	-	-	-	3	-	-
CO3	3	2	2	-	-	1	-	1.5	-	-	-	-	3	-	-
CO4	1	2	3	-	-	-	-	1.5	-	-	-	-	3	-	-
CO5	1	1	3	-	-	1	-	1.5	-	-	-	-	3	3	2
CO6	3	3	3	-	-	-	-	1.5	-	-	-	-	3	3	3
Avg	2.2	2	2.6	1	-	1	-	1.5	-	-	-	-	3	3	2.5

24153C62P- DIGITAL ELECTRONICS 3 1 0 4

COURSE OBJECTIVES:

- To introduce the fundamentals of combinational and sequential digital circuits.
- To study various number systems and to simplify the mathematical expressions using Boolean functions word problems
- To study implementation of combinational circuits using Gates` and MSI Devices.
- To study the design of various synchronous and asynchronous circuits
- To introduce digital simulation techniques for development of application oriented logic circuit

UNIT I DIGITAL FUNDAMENTALS

Number Systems — Decimal, Binary, Octal, Hexadecimal, 1?s and 2?s complements, Codes — Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine- McCluskey method of minimization.

UNIT II COMBINATIONAL CIRCUIT DESIGN

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder — Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS

Flip flops — SR, JK, T, D, Master/Slave FF — operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits — Design

— Moore/Mealy models, state minimization, state assignment, circuit implementation — Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits

UNIT V MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS

Basic memory structure — ROM -PROM — EPROM — EEPROM –EAPROM, RAM — Static and dynamic RAM — Programmable Logic Devices — Programmable Logic Array (PLA) — Programmable Array Logic (PAL) — Field Programmable Gate Arrays (FPGA) — Implementation of combinational logic circuits using PLA, PAL. Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics-RTL, TTL, ECL, CMOS

COURSE OUTCOMES:

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

CO1: Explain various number systems and characteristics of digital logic families

CO2: Apply K-maps and Quine McCluskey methods to simplify the given Boolean

expressions

CO3: Explain the implementation of combinational circuit such as multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders

CO4: Design various synchronous and asynchronous circuits using Flip Flops CO5: Explain asynchronous sequential circuits and programmable logic devices

CO6: Use VHDL for simulating and testing RTL, combinatorial and sequential circuits

TEXTBOOKS:

5. Morris Mano.M, 'Digital Logic and Computer Design', Prentice Hall of India, 3rd Edition, 2005.
6. Donald D.Givone, 'Digital Principles and Design', Tata McGraw Hill,1st Edition, 2003
7. Thomas L Floyd, 'Digital fundamentals', Pearson Education Limited, 11th Edition, 2018

REFERENCES:

i. Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia, 12th Edition, 2017.

ii. Donald P Leach, Albert Paul Malvino, Goutam Sha, 'Digital Principles and Applications', Tata McGraw Hill, 7th Edition, 2010.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
CO2	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
CO3	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
CO4	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
CO5	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
Avg	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1

24153C63P- POWER SYSTEM OPERATION AND CONTROL 4 0 0 4

Semester VI

AIM

To become familiar with the preparatory work necessary for meeting the next day's operation and the various control actions to be implemented on the system to meet the minute-to-minute variation of system load.

OBJECTIVES

iii. To get an overview of system operation and control.
iv. To understand & model power-frequency dynamics and to design power-frequency controller.
v. To understand & model reactive power-voltage interaction and different methods of control for maintaining voltage profile against varying system load.

UNIT I INTRODUCTION 12

System load variation: System load characteristics, load curves - daily, weekly and annual, load-duration curve, load factor, diversity factor. Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Overview of system operation: Load forecasting, unit commitment, load dispatching. Overview of system control: Governor Control, LFC, EDC, AVR, system voltage control, security control.

UNIT II REAL POWER - FREQUENCY CONTROL 12

Fundamentals of Speed Governing mechanisms and modeling - Speed-Load characteristics-regulation of two Synchronous Machines in parallel - Control areas - LFC of single & Multi areas - Static & Dynamic Analysis of uncontrolled and controlled cases –Tie line with frequency bias control – Steady state instabilities.

UNIT III REACTIVE POWER–VOLTAGE CONTROL 12

Typical excitation system, modeling, static and dynamic analysis, stability compensation; generation and absorption of reactive power: Relation between voltage, power and reactive power at a node; method of voltage control: Injection of reactive power. Tap-changing transformer, numerical problems - System level control using generator voltage magnitude setting, tap setting of OLTC transformer.

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH 12

Statement of Unit Commitment (UC) problem; constraints in UC: spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints; UC solution methods: Priority-list methods, forward dynamic programming approach, numerical problems only in priority-list method using full-load average production cost. Incremental cost curve, co-ordination equations without loss and with loss, solution by direct method and λ-iteration method. (No derivation of loss coefficients.) Base point and participation factors.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 12

Energy control centre: Functions – Monitoring, data acquisition and control. System hardware configuration – SCADA and EMS functions: Network topology determination, state estimation, security analysis and control. Various operating states: Normal, alert, emergency, in extremis and restorative. State transition diagram showing various state transitions and control strategies. **Total = 60**

COURSE OUTCOMES

Ability to understand the day-to-day operation of electric power system.

Ability to analyze the control actions to be implemented on the system to meet the minute- to-minute variation of system demand.

Ability to understand the reactive power-voltage interaction.

TEXT BOOKS

1. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Ltd, New Delhi, Second Edition, 2003.
2. Allen.J.Wood and Bruce F.Wollenberg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2003.
3. P. Kundur, 'Power System Stability & Control', McGraw Hill Publications, USA, 1994.

REFERENCE BOOKS

1. D.P. Kothari and I.J. Nagrath, 'Modern Power System Analysis', Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. L.L. Grigsby, 'The Electric Power Engineering, Hand Book', CRC Press & IEEE Press, 2001.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	1	-	-	-	2	3	3	3
CO2	3	2	1	1	-	1	-	2	-	2	-	2	3	3	3
CO3	3	2	1	1	-	1	-	2	-	2	-	2	3	3	3
CO4	3	2	1	1	-	1	-	2	-	2	-	2	3	1	2.33
CO5	2	1	-	-	-	-	-	1	-	2	-	2	3	3	3
Avg.	2	1.6	1	1	-	1	-	1.6	-	2	-	2	3	2.2	2.86

24153E64GP **HYBRID ENERGY TECHNOLOGY** **LT P C**
3 0 0 3

COURSE OBJECTIVES:

- To provide knowledge about different types of hybrid energy systems.
- To analyze the various electrical Generators used for the Wind Energy Conversion Systems.
- To design the power converters used in SPV Systems.
- To analyze the various power converters used in hybrid energy systems and to understand the importance of standalone and grid-connected operation in Hybrid renewable energy systems.
- To analyze the performance of the various hybrid energy systems

UNIT I INTRODUCTION TO HYBRID ENERGY SYSTEMS 9

Hybrid Energy Systems – Need for Hybrid Energy Systems – Solar-Wind-Fuel Cell-Diesel, Wind- Biomass-Diesel, Micro-Hydel-PV, Ocean and geyser energy - Classification of Hybrid Energy systems – Importance of Hybrid Energy systems – Advantages and Disadvantages - Environmental aspects of renewable energy - Impacts of renewable energy generation on the environment - Present Indian and international energy scenario of conventional and RE sources - Ocean energy, Hydel Energy - Wind Energy, Biomass energy, Hydrogen energy - Solar Photovoltaic (PV) and Fuel cells: Operating principles and characteristics.

UNIT II ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS (WECS) 9

Review of reference theory fundamentals –Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT III POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS 9

Power Converters for SPV Systems **-** Line commutated converters (inversion-mode) - Boost and buck- boost converters- selection of inverter, battery sizing, array sizing - Analysis of SPV Systems - Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems,

UNIT IV ANALYSIS OF POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS 9

Introduction to Power Converters **–** Stand-alone Converters -AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters - Bi-Directional Converters - Grid-Interactive Inverters - Matrix converter – Merits and Limitations.

UNIT V CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS 9

Hybrid Systems- Range and type of Hybrid systems – Performance Analysis – Cost Analysis - Casestudies of Diesel-PV, Wind-PV-Fuel-cell, Micro-hydel-PV, Biomass-Diesel-Fuel-cell systems.

TOTAL : 45 PERIODS

10

COURSE OUTCOMES:

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

CO1: Analyze the impacts of hybrid energy technologies on the environment anddemonstrate them to harness electrical power.

CO2: Select a suitable Electrical machine for Wind Energy Conversion Systems and simulatewind energy conversion system

CO3: Design the power converters such as AC-DC, DC-DC, and AC-AC converters forSPV systems.

CO4: Analyze the power converters such as AC-DC, DC-DC, and AC-AC converters forHybrid energy systems.

CO5: Interpret the hybrid renewable energy systems.

TEXTBOOKS:

1. Bahman Zohuri, "Hybrid Energy Systems", Springer, First Edition, 2018.
2. S.M. Muyeen, "Wind Energy Conversion Systems", Springer First Edition, 2012
3. Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd Hasan Ali, "Emerging Power Converters forRenewable Energy and Electric Vehicles", CRC Press, First Edison, 2021

REFERENCES:

1. Ernst Joshua, Wind Energy Technology, PHI, India, 2018, 3rd Edition.
2. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 7thImpression, 2005.
3. Rashid.M. H "Power electronics Hand book", Academic press,4th Edition, 2018.
4. Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017.
5. Rai. G.D, "Solar energy utilization", Khanna publishers, 3rd Edition, 1987.
6. Gray, L. Johnson, "Wind energy system", Prentice Hall of India, 2nd Edition, 2006.
7. B.H.Khan "Non-conventional Energy sources", Tata McGraw hill Publishing Company, New Delhi,2017, 3rd Edition.

List of Open Source Software/ Learning website:

1. https://www.sciencedirect.com/topics/engineering/hybrid-energy-system
2. https://www.sciencedirect.com/topics/engineering/wind-energy-conversion-system
3. https://www.academia.edu/35619294/Modeling_and_Performance_Analysis_of_Solar_PV_S
4. System_and_DC_DC_Converters
5. https://www.mdpi.com/journal/energies/special_issues/Power_Converter_Electric_Machines
6. _Renewable_Energy_Systems_Transportation
7. https://www.intechopen.com/chapters/64317

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	3	-	3	3	3	3
CO2	3	3	3	2	3	-	-	-	-	3	-	3	3	3	3
CO3	3	3	3	2	3	-	-	-	-	3	-	3	3	3	3
CO4	3	3	3	2	3	-	-	-	-	3	-	3	3	3	3
CO5	3	3	3	2		-	-	-	-	3	-	3	3	3	3
Avg	3	3	3	2	3	-	-	-	-	3	-	3	3	3	3

24153L65P POWER SYSTEMS LAB 0 0 3 2

AIM

To simulate analysis and planning cases for a practical power system.

List Of Experiments:

1. Formation of Y-Bus Matrix by Inspection and Singular transformation methods.
2. Load flow solution using Gauss Seidal method
3. Load flow solution using Newton-Raphson method
4. Load flow solution by Fast Decoupled method
5. Symmetrical short circuit analysis
6. Unsymmetrical Fault analysis
7. Solution of swing Equation using modified Euler method
8. Power Electronic Circuits, design and simulation using Pspice
9. Simulation of Electrical drives using MATLAB, PSCAD
10. Control system design using MATLAB

COURSE OUTCOMES

- Ability to understand power system planning and operational studies.
- Ability to acquire knowledge on Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
- Ability to analyze the power flow using GS and NR method Ability to find Symmetric and Unsymmetrical fault

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
Avg.	3	3	3	2.8	1	1	1	1	1	1	1	1	2	2	2

Semester VII

24160S71P TOTAL QUALITY MANAGEMENT 3 0 0 3

UNIT – I: BASICS OF TQM 9

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT – II: PRINCIPLES OF TQM 9

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT – III: QUALITY CONCEPTS 9

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Concept of six sigma,

UNIT – IV: TQM TOOLS 9

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, FMEA – Stages of FMEA.

UNIT – V: ISO STANDARDS 9

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, ISO 14000 – Concept, Requirements and Benefits.

TOTAL : 45

COURSE OUTCOMES

Upon completion of the course, students will be ability to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

TEXT BOOKS:

1. Dale H. Besterfiled, et al., "Total Quality Management", Pearson Education, Inc. 2003. (Indian reprint 2004). ISBN 81-297-0260-6.
2. Basker, " TOTAL QUALITY MANAGEMENT", Anuradha Agencies.

REFERENCES:

Feigenbaum.A.V. "Total Quality Management", McGraw Hill, 1991

Oakland.J.S. "Total Quality Management", Butterworth – Hcinemann Ltd.,Oxford. 1989.

Narayana V. and Sreenivasan, N.S. "Quality Management – Concepts and Tasks", New Age International 1996

COs- POs & PSOs MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3										3	2		3
2						3						3		2	
3					3				3					2	3
4		2			3	2	3	2				3	3	2	
5			3			3	3	2							
AVg.		2.5	3		3	2.6	3	2	3			3	2.5	2	3

24153C72P - ELECTRICAL MACHINE DESIGN 3 1 0 4

Semester VII

AIM

To expose the students to the construction, principle of operation and performance of special electrical machines as an extension to the study of basic electrical machines.

OBJECTIVES

To impart knowledge on

i. Construction, principle of operation and performance of DC machine.
ii. Construction, operating Characteristics of single and three phase transformer.
iii. Design and operating characteristics of Induction motors.
iv Construction, principle of operation, Design of synchronous machines and to have knowledge of machine design in CAD

UNIT I INTRODUCTION 9

Major considerations – Limitations – Electrical Engineering Materials – Space factor – temperature gradient – Heat flow in two dimensions – thermal resistivity of winding – Temperature gradient in conductors placed in slots – Rating of machines – Eddy current losses in conductors – Standard specifications

UNIT II DC MACHINES 9

Constructional details – output equation – main dimensions - choice of specific loadings
– choice of number of poles – armature design – design of field poles and field coil – design of commutator and brushes – losses and efficiency calculations.

UNIT III TRANSFORMERS 9

KVA output for single and three phase transformers – Window space factor – Overall
dimensions – Operating characteristics – Regulation – No load current – Temperature rise of Transformers – Design of Tank with & without cooling tubes – Thermal rating – Methods of cooling of Transformers.

UNIT IV INDUCTION MOTORS 9

Magnetic leakage calculations – Leakage reactance of polyphase machines- Magnetizing
current – 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-Operating characteristics –Short circuit current – circle diagram – Dispersion co-efficient – relation between D & L for best power factor.

UNIT V SYNCHRONOUS MACHINES 9

Runaway speed – construction – 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 – Determination of full load field m.m.f – Design of field winding – Design of turboalternators – Rotor design - Introduction to computer aided design – Program to design main dimensions of Alternators.

Total = 60

COURSE OUTCOMES

Ability to understand basics of design considerations for rotating and static electrical machines

Ability to design of field system for its application.

Ability to design sing and three phase transformer.

Ability to design armature and field of DC machines.

REFERENCE BOOKS:

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 1984.
2. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.

COs- POs & PSOs MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3										3	2		3
2						3						3		2	
3					3				3					2	3
4		2			3	2	3	2				3	3	2	
5			3			3	3	2							
AVg.		2.5	3		3	2.6	3	2	3			3	2.5	2	3

24153C73P- POWER PLANT ENGINEERING

4 0 0 4
Semester VII

UNIT I -THERMAL POWER PLANTS 9

Basic thermodynamic cycles – Various components of steam power plant – Layout – Pulverized coal burners – Fluidized bed combustion – Coal handling systems – Ash handling systems – Forced draft and induced draft fans – Boilers – Feed pumps – Super heater – Regenerator – Condenser – Deaerators – Cooling tower

UNIT II - HYDRO ELECTRIC POWER PLANTS 9

Layout – Dams – Selection of water turbines – Types – Pumped storage hydel plants

UNIT III - NUCLEAR POWER PLANTS 9

Principles of nuclear energy – Fission reactions – Nuclear reactor – Nuclear power plants

UNIT IV- GAS AND DIESEL POWER PLANTS 9

Types – Open and closed cycle gas turbine – Work output and thermal efficiency – Methods to improve performance – Reheating, intercoolings, regeneration – Advantage and disadvantages – Diesel engine power plant – Component and layout

UNIT V- NON – CONVENTIONAL POWER GENERATION 9

Solar energy collectors – OTEC – Wind power plants – Tidal power plants and geothermal resources – Fuel cell – MHD power generation – Principle – thermoelectric power generation – Thermionic power generation.

L: 45 T: 15 Total: 60

COURSE OUTCOMES

Ability to create awareness about renewable Energy Sources and technologies.

Ability to get adequate inputs on a variety of issues in harnessing renewable

Energy.

Ability to recognize current and possible future role of renewable energy sources.

TEXT BOOKS

1. Arora and Domkundwar, "A Course in Power Plant Engineering", Dhanpat Rai.
2. Nag, P.K., "Power Plant Engineering", 2nd Edition, Tata McGraw Hill, 2003.

REFERENCES

1. Bernhardt, G.A., Skrotzki and William A. Vopat, "Power Station Engineering and Economy", 20th Reprint, Tata McGraw Hill, 2002.
2. Rai, G.D., "An Introduction to Power Plant Technology", Khanna Publishers.
3. El-Wakil, M.M., "Power Plant Technology", Tata McGraw Hill, 198

COs- POs & PSOs MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3										3	2		3
2						3						3		2	
3					3				3					2	3
4		2			3	2	3	2				3	3	2	
5			3			3	3	2							
AVg.		2.5	3		3	2.6	3	2	3			3	2.5	2	3

ELECTIVE-I

24153E44AP- DESIGN OF ELECTRIC VEHICLE CHARGING SYSTEM

3 1 0 4

Semester-IV

AIM

To expose the students to the fundamentals of electromagnetic fields and their applications in Electrical Engineering**.**

OBJECTIVES:

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of electrostatics, electrical potential, energy density and their applications.
- To impart knowledge on the concepts of magneto statics, magnetic flux density, scalar and vector potential and its applications.
- To impart knowledge on the concepts of Faraday's law, induced Emf and Maxwell's equations
- To impart knowledge on the concepts of Concepts of electromagnetic waves and Pointing vector.

UNIT I: **ELECTROSTATICS – I** **12**

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields – Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications

UNIT II: **ELECTROSTATICS – II** **12**

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization – Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

UNIT III: MAGNETOSTATICS **12**

Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H 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, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications

UNIT IV: ELECTRODYNAMIC FIELDS **12**

Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications

UNIT V: ELECTROMAGNETIC WAVES **12**

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics,

conductors- skin depth - Poynting vector – Plane wave reflection and refraction – Standing Wave – Applications.

TOTAL = 45

COURSE OUTCOMES

Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.

TEXT BOOKS

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 4 th Edition ,Oxford University Press Inc, First India edition, 2009.
2. Ashutosh Pramanik, 'Electromagnetism – Theory and Applications', PHI Learning Private Limited, New Delhi, Second Edition-2009.
3. K.A. Gangadhar, P.M. Ramanthan ' Electromagnetic Field Theory (including Antennaes and wave propagation', 16th Edition, Khanna Publications, 2007..

REFERENCE BOOKS

1. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition Schaum's Outline Series), Tata McGraw Hill, 2010.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill 8th Revised edition, 2011.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.
4. Bhag Singh Guru and Hüseyin R. Hiziroglu "Electromagnetic field theory Fundamentals", Cambridge University Press; Second Revised Edition, 2009

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MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	2	2	-	3	-	3	3	--	-
CO2	3	3	3	3	-	-	2	2	-	3	-	3	3	3	3
CO3	3				-	-			-		-		3	3	3
CO4	3	3	3	3	-	-	2	2	-	2	-	1	3	3	3
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	3	3
CO6	3	3	3	3	3	-	2	2	-	3	-	2	3	3	3
Avg	3	3	3	3	3	-	2	2	-	2.75	-	2.25	3	3	3

ELECTIVE-I

24153E44BP- FUZZY LOGIC AND ITS APPLICATIONS

3 1 0 4

Semester-IV

UNIT I -FUZZY LOGIC **7**

Fuzzy sets – Fuzzy operation – Fuzzy arithmetic – Fuzzy relational equations – Fuzzy measure – Fuzzy functions – approximate reasoning – Fuzzy proposition – Fuzzy quantifiers-if-then rules.

UNIT II- FUZZY LOGIC IN CONTROL **8**

Structure of Fuzzy logic controller – Fuzzification models – database – rule base – inference engine – defuzzification modules – Non-Linear fuzzy control – PID like FLC – Sliding mode FLC – Sugeno FLC – adaptive fuzzy control applications – case studies.

UNIT III- NEURAL NETWORKS IN CONTROL **8**

Neural Network for Non-Linear systems – schemes of Neuro control-system identification forward model and inverse model – indirect learning neural network control applications – Case studies.

UNIT IV- MODELING AND CONTROL OF FACTS DEVICES NEURAL AND FUZZY TECHNIQUE **10**

FACTS-concept and general system considerations, types of FACTS devices – special purpose FACTS devices, generalized and multifunctional FACTS devices – General comments on transient stability programs.Neuro – Fuzzy based FACTS controller for improvement of Transient stability systems – GA for Adaptive fuzzy system – case study.

UNIT V- STABILITY STUDIES UNDER MULTIPLE FACTS ENVIRONMENT **12**

Introduction to small signal analysis – simulation and modeling of FACTS controllers for small signal analysis. Comparison between dynamic and transient stability results. Introduction to EMTP – (Electromagnetic Transient programme / Package), Modeling of FACTS controllers for power system studies using EMTP.

TOTAL=45

COURSE OUTCOMES

- Ability to design combinational and sequential Circuits.

  Ability to simulate using software package.
- Ability to study various number systems and simplify the logical expressions
- using Boolean functions
- Ability to design various synchronous and asynchronous

  circuits. Ability to introduce asynchronous sequential

  circuits and PLDs

- Ability to introduce digital simulation for development of application oriented logic circuits.

REFERENCES:

1. KOSKO. B. "Neural Networks and Fuzzy systems", Prentice-Hall of India Pvt.Ltd., 1994.
2. Driankov, Hellendroon, "Introduction to Fuzzy control" Narosa Publisher.
3. Ronald R.Yager and Dimitar P.Filev "Essential of fuzzy modeling and control " John Wiley & Sons, Inc.
4. Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho" FACTS – Modeling and simulation in Power Networks" John Wiley & Sons.
5. Kundur P., "Power system stability and control", McGraw Hill, 1994.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	1	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	3	1	1	1	1	1	1	1	1	2	2	2
Avg.	3	3	3	2.8	1	1	1	1	1	1	1	1	2	2	2

ELECTIVE-I

24153E44CP - BIOMEDICAL INSTRUMENTATION

4 0 0 4

Semester-IV

AIM

The course is designed to make the student acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical importance. The fundamental principles of equipment that are actually in use at the present day are introduced.

OBJECTIVES

i. To provide an acquaintance of the physiology of the heart, lung, blood circulation and circulation respiration. Methods of different transducers used.
ii. To introduce the student to the various sensing and measurement devices of electrical origin.
iii. To provide the latest ideas on devices of non-electrical devices.
iv. To bring out the important and modern methods of imaging techniques.
v. To provide latest knowledge of medical assistance / techniques and therapeutic equipments.

UNIT I BASIC PHYSIOLOGY 9

Cells and their structures – Transport of ions through cell membrane – Resting and excited state – Tran membrane potential – Action potential – Bio-electric potential – Nervous system – Physiology of muscles – Heart and blood circulation – Respiratory system – Urinary system.

UNIT II BASIC TRANSDUCER PRINCIPLES AND ELECTRODES 9

Transducer principles - Active transducers - Passive transducers -Transducer for Bio-medical application -Electrode theory- Bio-potential electrode - Bio - chemical transducer.

UNIT III CARDIOVASCULAR SYSTEM 9

The heart and cardiovascular system – Blood pressure – Characteristics of blood flow – Heart sounds - Electro cardiography – Measurements of blood pressure – Measurement of blood flow and cardiac O/P Plethysmography – Measurements of heart sounds.

UNIT IV X-RAY AND RADIOISOTOPE INSTRUMENTATION 9

X-ray imaging radiography – Fluoroscopy – Image intensifiers – Angiography - Medical use of radioisotopes – Beta radiations – Detectors – Radiation therapy.

UNIT V BIO-TELEMETRY 9

Introduction to biotelemetry – Physiological parameters adaptable to biotelemetry – the components of biotelemetry systems – Implantable units – Applications of telemetry in patient care – Application of computer in Bio-medical instrumentation, Anatomy of Nervous system – Measurement from the nervous system – EEG – EMG.

Total = 45

COURSE OUTCOMES

- Ability to understand fundamentals of Bio medical instrumentation.
- To acquire knowledge on Bio-Medical and Non-Electrical parameter measurements.

- To know the various medical imaging equipment.

REFERENCE BOOKS:

1. Lesis Cromwell Fred, J.Werbell and Erich A.Pfraffer, Biomedical instrumentation and Measurements – Prentice Hall of India, 1990.
2. M.Arumugam, Bio-medical Instrumentation – Anuradha Agencies Publishers, 1992.
3. Khandpur, Handbook on Biomedical Instrumentation – Tata McGraw Hill Co Ltd., 1989.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
CO2	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
CO3	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
CO4	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
CO5	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1
Avg.	2	2	3	2	2	-	-	1	-	-	-	1	3	-	1

ELECTIVE-I
Semester-IV

24153E44DP - MODELING AND SIMULATION OF SOLAR ENERGY SYSTEMS

4 0 0 4

UNIT I: SOLAR RADIATION AND COLLECTORS 9

Solar angles - day length, angle of incidence on tilted surface - Sunpath diagrams - shadow determination - extraterrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - heat capacity effect - testing methods-evacuated tubular collectors - concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors.

UNIT I: APPLICATIONS OF SOLAR THERMAL TECHNOLOGY 9

Principle of working, types - design and operation of - solar heating and cooling systems - solar water heaters – thermal storage systems – solar still – solar cooker – domestic, community – solar pond – solar drying.

UNIT III: SOLAR PV FUNDAMENTALS 9

Semiconductor – properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetro junctions - metal-semiconductor interface - dark and illumination characteristics - figure of merits of solar cell – efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells - preparation of metallurgical, electronic and solar grade Silicon - production of single crystal Silicon: Czokralski (CZ) and Float Zone (FZ) method - Design of a complete silicon – GaAs- InP solar cell - high efficiency III-V, II-VI multi junction solar cell; a-Si-H based solar cells-quantum well solar cell -thermophotovoltaics.

UNIT IV: SOLAR PHOTOVOLTAIC SYSTEM DESIGN AND APPLICATIONS 9

Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking – use of computers in array design - quick sizing method - array protection and trouble shooting - centralized and decentralized SPV systems - stand alone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

UNIT V: SOLAR PASSIVE ARCHITECTURE 9

Thermal comfort - heat transmission in buildings- bioclimatic classification – passive heating concepts: direct heat gain - indirect heat gain - isolated gain and sunspaces - passive cooling concepts: evaporative cooling - radiative cooling - application of wind, water and earth for cooling; shading - paints and cavity walls for cooling - roof radiation traps - earth air-tunnel. – energy efficient landscape design - thermal comfort – concept

of solar temperature and its significance - calculation of instantaneous heat gain through building envelope.

TOTAL: 45

COURSE OUTCOMES

Basic knowledge in Power system planning, operation and modeling of large scale power systems.

Ability to understand the various faults occurring in power system and to solve load flow problems using numerical methods.

Ability to analyze the power system transients and faults and select the rating for protective devices.

TEXT BOOKS:

1. Sukhatme S P, Solar Energy, Tata McGraw Hill, 1984.
2. Kreider, J.F. and Frank Kreith, Solar Energy Handbook, McGraw Hill, 1981.
3. Goswami, D.Y., Kreider, J. F. and & Francis., Principles of Solar Engineering, 2000.

REFERENCES:

1. Garg H P., Prakash J., Solar Energy: Fundamentals & Applications, Tata BMcGraw Hill, 2000.
2. Duffie, J. A. and Beckman, W. A., Solar Engineering of Thermal Processes, John Wiley, 1991.
3. Alan L Fahrenbruch and Richard H Bube, Fundamentals of Solar Cells: PV Solar Energy Conversion, Academic Press, 1983.
4. Larry D Partain, Solar Cells and their Applications, John Wiley and Sons, Inc, 1995.
5. Roger Messenger and Jerry Vnetre, Photovoltaic Systems Engineering, CRC Press, 2004.
6. Sodha, M.S, Bansal, N.K., Bansal, P.K., Kumar, A. and Malik, M.A.S. Solar Passive Building, Science and Design, Pergamon Press, 1986.
7. Krieder, J and Rabi, A., Heating and Cooling of Buildings: Design for Efficiency, McGraw-Hill, 1994.

MAPPING OF COS AND POS:

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3								2			1	3	
2		3												2	2
3		2													
4	2	3	3		2								2	3	
5	3	3	3		2								2		2
AVg.	2.5	2.4	3		2					2			1.8	2.6	2

24153E44EP NON-CONVENTIONAL ENERGY SYSTEMS AND APPLICATIONS 2 0 2 4

AIM

To learn about the Renewable energy system and conversion technologies related to various aspects of non-conventional systems.

OBJECTIVES

to identify suitable utility for the solar and wind energy systems,

to conduct a site survey for installation of a windmill during Sixth Expedition ,

to study the structural and foundation aspects for installing a windmill at Maitree station in Schirmacher hills

UNIT-I **9**

Introduction to renewable energy various aspects of energy conversion-Principle of renewable energy systems environment and social implications

UNIT-II **9**

Solar energy: Solar radiation components- measurements-estimation-solar collectors-solar water heaters- Calculation-Types-analysis-economics-Applications Solar thermal power generation Solar Photovoltaics- energy conversion principle-classifications-equivalent circuit-characteristics-Cell efficiency- Limitations-PV modules-MPPT algorithms

UNIT-III **9**

Wind energy: Basics of wind-wind turbines-power and energy from wind turbine-characteristics- types of electric generators for wind power generation. Dynamics matching- performance of wind generators - applications- economics of wind power

UNIT-IV **9**

Storage Devices: Super capacitor-SMES- Battery storage-flywheel storage- compressed air storage- Fuel cells–types and applications; MHD generators – backup -System design-industrial and domestic applications.

UNIT-V **9**

Bioenergy: Bio fuels-classification-biomass conversion technologies-applications; Ocean Energy: Tidal energy-wave energy-ocean thermal energy conversion systems-applications; - mini, micro and pico hydel power

Total : 45

TEXT/REFERENCE BOOKS:

1. Godfrey Boyle, “Renewable Energy: Power for a sustainable future”, Oxford University press, Second edition.

2. Rai G D, “Solar Energy Utilization”, Khanna Publishers, 1997.
3. B H Khan, “Non-Conventional Energy Resources”, The McGraw-Hill Companies, Second Edition.
4. Sukhatme, S.P, “Solar Energy -Principles of Thermal Collection and Storage”, Tata
5. McGraw-Hill, 2 ed., 1997.
6. Sammes, Nige, “Fuel Cell Technologies-State and Perspectives”, Springer publication, 2005
7. Kreith, F., and Kreider, J.F., “Principles of Solar Engineering”, Mc-Graw-Hill Book Co, 1978.
8. S.L.Soo , “Direct Energy Conversion” , Prentice Hall Publication, 1968
9. James Larminie, Andrew Dicks, **“**Fuel Cell Systems”, Wiley & Sons Ltd, 2ed, 2003.

MAPPING OF COS AND POS:

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3								2			1	3	
2		3												2	2
3		2													
4	2	3	3		2								2	3	
5	3	3	3		2								2		2
AVg.	2.5	2.4	3		2					2			1.8	2.6	2

ELECTIVE-II SEMESTER-V

24153E54AP - ENVIRONMENTAL SCIENCE AND ENGINEERING 4 0 0 4

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I- INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES **10**

Definition, scope and importance – need for public awareness – forest resources: use and over-exploitation, deforestation,. Timber extraction, mining, dams-benefits and problems – mineral resources: use and effects on forests and tribal people – water resources: use and over-utilization of surface and exploitation, environmental effects of extracting and using mineral resources, case studies – food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies – land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources.

UNIT II-ECOSYSTEMS AND BIODIVERSITY **14**

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem. Introduction to biodiversity – definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity –endangered and endemic species of India – conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT III -ENVIRONMENTAL POLLUTION **8**

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 — role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.

UNIT IV-SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management

environmental ethics: issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents. environment production act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – wildlife protection act – forest conservation act – issues involved in enforcement of environmental legislation – public awareness

UNIT V-HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – hiv / aids – women and child welfare – role of information technology in environment and human health – case studies.

TOTAL : 45

COURSE OUTCOMES

- Play a important role in transferring a healthy environment for future generations
- Analyze the impact of engineering solutions in a global and societal context
- Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems

TEXT BOOKS

1. Gilbert M .Masters, "Introduction to Environmental Engineering and Science", Pearson Education Pvt., Ltd., Second Edition, ISBN 81-297-0277-0, 2004.
2. Miller T.G. Jr., "Environmental Science", Wadsworth Publishing Co.

REFERENCES

1. Bharucha Erach, "The Biodiversity of India", Mapin Publishing Pvt. Ltd., Ahmedabad India.
2. Trivedi R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
3. Cunningham, W.P.Cooper, T.H.Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
4. Wager K.D. "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.
5. Townsend C., Harper J and Michael Begon, "Essentials of Ecology, Blackwell Science.
6. Trivedi R.K. and P.K. Goel, Introduction to Air Pollution, Techno-Science Publications.

COs- POs & PSOs MAPPING

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1	2	2	2	1	1	2	1	1	1	1	1	1
2	3	3	2	3	2	2	2	2	3	1	2	1	1	2	1
3	3	3	3	3	3	3	2	2	3	1	2	1	1	2	1
4	3	3	2	3	3	2	2	2	2	1	1	1	1	1	1
5	3	3	1	2	2	2	2	2	2	1	1	1	1	1	1
AVg.	2.8	2.8	1.8	2.6	2.6	2.2	1.8	1.8	2.4	1	1.4	1	1	1.4	1

ELECTIVE-II
Semester-v

24153E54BP -ARTIFICIAL NEURAL NETWORKS 4 0 0 4

UNIT I : INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS 12

Biological neural networks - Pattern analysis tasks: Classification, Regression, Clustering - Computational models of neurons - Structures of neural networks - Learning principles

UNIT II: LINEAR MODELS FOR REGRESSION AND CLASSIFICATION 12

Polynomial curve fitting - Bayesian curve fitting - Linear basis function models - Bias-variance decomposition - Bayesian linear regression - Least squares for classification - Logistic regression for classification- Bayesian logistic regression for classification

UNIT III: FEEDFORWARD NEURAL NETWORKS 12

Pattern classification using preceptor - Multilayer feed forward neural networks (MLFFNNs) - Pattern classification and regression using MLFFNNs - Error back propagation learning - Fast learning methods: Conjugate gradient method – Auto associative neural networks - Bayesian neural networks

UNIT III: RADIAL BASIS FUNCTION NETWORKS 12

Regularization theory - RBF networks for function approximation - RBF networks for pattern classification

UNIT IV: KERNEL METHODS FOR PATTERN ANALYSIS 12

Statistical learning theory- Support vector machines for pattern classification- Support vector regression for function approximation- Relevance vector machines for classification and regression

UNIT V: SELF-ORGANIZING MAPS 12

Pattern clustering- Topological mapping- Kohonen's self-organizing map

FEEDBACK NEURAL NETWORKS

Pattern storage and retrieval- Hopfield model- Boltzmann machine- Recurrent neural networks

TOTAL=60

COURSE OUTCOMES

- Analysis of transients using various parametric & non parametric methods.
- Analysis of various control schemes usend for controlling applications
- study about the adaptive control systems for various applications & study of issues in it.

Text Books:

1. B.Yegnanarayana, Artificial Neural Networks, Prentice Hall of India, 1999
2. Satish Kumar, Neural Networks – A Classroom Approach, Tata McGraw-Hill, 2003
3. S.Haykin, Neural Networks – A Comprehensive Foundation, Prentice Hall, 1998
4. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
CO2	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
CO3	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
CO4	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
CO5	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1
Avg	3	3	3	1	3	-	-	1	-	-	-	1	3	-	1

ELECTIVE-II
Semester-v

24153E54CP-VLSI DESIGN 3 1 0 4

OBJECTIVES:

In this course, the MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit is studied.

Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed.

The main focus in this course is on the transistor circuit level design and realization for digital

UNIT I MOS TRANSISTOR PRINCIPLE 9

NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling, Scaling principles and fundamental limits, CMOS inverter scaling, propagation delays, Stick diagram, Layout diagrams

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Examples of Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Low power design principles

UNIT III SEQUENTIAL LOGIC CIRCUITS 9

Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory architecture and memory control circuits, Low power memory circuits, Synchronous and Asynchronous design

UNIT IV DESIGNING ARITHMETIC BUILDING BLOCKS 9

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, accumulators, Multipliers, dividers, Barrel shifters, speed and area tradeoff

UNIT V IMPLEMENTATION STRATEGIES 9

Full custom and Semi custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.

TOTAL 45

COURSE OUTCOMES

Upon completion of the course, students should

Explain the basic CMOS circuits and the CMOS process technology.
Discuss the techniques of chip design using programmable devices.
Model the digital system using Hardware Description Language.

TEXTBOOKS:

6. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2003.
7. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997

REFERENCES:

1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addision Wesley 1993

2. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005

3. A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	-	-	-	-	-	-	-	2	2	3
CO2	3	1	2	3	1	-	-	-	-	-	-	-	1	1	3
CO3	3	2	2	2	3	-	-	-	-	-	-	-	2	1	3
CO4	3	2	2	2	3	-	-	-	-	-	-	-	2	2	3
CO5	3	2	1	3	3	-	-	-	1	-	-	-	2	2	3
Avg	3	1.6	1.6	2.4	2.2	-	-	-	1	-	-	-	1.8	1.6	3

ELECTIVE-II
Semester-v

24153E54DP- ROBOTICS

3 1 0 4

UNIT I: INTRODUCTION **9**

Robot ,its evaluation; definition and aes of robotics, present application status.

UNIT II: ROBOT ANATOMY **9**

configuration, robot motions, work volume. Robot drives, actuators and control; Functions and types of drives and actuators; concept of basic control systems, open loop, close loop, different type of controllers, ON-OFF, proportional, integral, PI, PD, PID.

UNIT III: ROBOT END EFFECTORS: **9**

Types of end effecters, mechanical gripper, tools and end effectors. Robot sensors: Transducers and sensors; analog and digital transducers; types of sensors, tachfile sensors, proximity and rough sensors ; miscellaneous sensors; vision systems; use of sensors in robotics.

UIT IV: ROBOT KINEMATICS **9**

Position representations; forward and reverse kinematics of three and four degrees of freedom; robot arm; homogeneous transformations and robot kinematics; kinematics equations using homogeneous transformation .

UNIT V: INDUSTRIAL APPLICATION **9**

Capabilities of robots; robot applications; materials handling; pick and place operation; palletiging and depalletiging; machine loading and unloading; machine casting; welding;painting,assembly; inspection; maintenance.

COURSE OUTCOMES

Ability to understand and develop MFC windows applications with inputs and drawing features and implement menus using VC++

Ability to understand document/view architecture and develop classic controls using VC++

Ability to understand and design event driven programming and activeX controls and manage database using visual basic

BOOKS RECOMMENDED:

1. Schilling-Fundamental of robotics; PH
2. Yoshikawa- Fundamental of robotics; PH
3. S.R.Deb-Robotics Technology and Flexible Automation
4. Introduction to Robotics, John J Craig; Pearson Education

CO's – PO's & PSO's MAPPING

COs	POs													PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2	
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2	
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2	
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2	
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3	
AVg.	3.00	2.60	2.40	2.00	3.00	-	-	-	2.80	2.20	1.80	2.60	2.80	1.80	2.20	

24153E54EP LT & HT DISTRIBUTION SYSTEMS 2 0 2 4

AIM

To become familiar with the function of different components used in Transmission and Distribution levels of power systems and modeling of these components.

OBJECTIVES

To develop expression for computation of fundamental parameters of Power system analysis.

To categorize the lines into different classes and develop equivalent circuits for these classes.

To analyze the voltage distribution in Architectures and user interface.

UNIT-I **9**

Power system-general concepts-distribution of power, load and energy forecasting-factors in power system loading, Power system analysis-load flow-fault studies-voltage control.

UNIT-II **9**

Optimization of distribution system network cost modeling-economic loading of distribution transformers. Distribution system reliability-reliability assessment techniques

UNIT-III **9**

Consumer services-maximum demand, diversity and load factor-consumer load control for power shortages, Tariffs-costing and pricing –economically efficient tariff structure. Overhead and underground lines-optimum design considerations, Power capacitors-size of capacitor for power factor improvement- HT and LT capacitor installation requirements.

UNIT-IV **9**

Distribution System Design- Electrical Design Aspects of Industrial, Commercials Buildings- Design, estimation and costing of outdoor and indoor Substations, Electrical Safety and Earthing Practices at various voltage levels- Lightning protection.-Regulations and standards.

UNIT-V **9**

Distribution Automation System : Necessity, System Control Hierarchy- Basic Architecture and implementation Strategies for SCADA and DAC systems -Basic Distribution Management System Functions. Communication Systems for Control and Automation- Wireless and wired Communications- SCADA and DAC communication Protocols, Architectures and user interface

Total: 45

Text/References:

1. Turan Gonen, "Electric Power Distribution system Engineering" Mc Graw-hill ,Inc,1987
2. A.S. Pabla, " Electric Power Distribution systems" Tata Mc Graw-hill Publishing company
limited, 4th edition, 1997.
3. Alexander Eigeles Emanuel, "Power Definitions and the Physical Mechanism of Power Flow", John Wiley & Sons, October 2009.
4. "Handbook of International Electrical Safety Practices", John Wiley & Sons, PERI June 2009.
5. Ali A. Chowdhury, Don O. Koval, "Power distribution system reliability-Practical methods and applications" John Wiley & sons Inc., *IEEE Press* 2009
6. Richard E.Brown, "Electric power distribution reliability" Taylor & Francis Group,LLC,2009.
7. James Northcote-Green, Robert Wilson, "Control and automation of electrical power distribution system", Taylor & Francis Group, LLC,2007.
8. S.Sivanagaraju, V.Sankar, Dhanpat Rai & Co, "Electrical Power Distribution and Automation",2006.
9. Pansini,Anthony J, "Guide to electrical power distribution system",Fairmont press, inc., 6th edition,2006.
10. Stuart A. Boyer, "SCADA-Supervisory Control and Data Acquisition" Instrument Society of America Publication,2004
11. Leveque, Francois , "Transport Pricing of Electricity Networks" Springer 2003
13. Lakervi & E J Holmes, "Electricity distribution network design", Peter Peregrimus Ltd. 2nd Edition,2003
13. William H. Kersting, "Distribution system modeling and analysis" CRC press LLC, 2002.
14. Michael Wiebe, "A Guide to Utility Automation: Amr, Scada, and It Systems for Electric Power" PennWell,1999.
15. IEEE Press: IEEE Recommended practice for Electric Power Distribution for Industrial Plants, publish

CO's – PO's & PSO's MAPPING

COs	POs													PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2	
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2	
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2	
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2	
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3	
AVg.	3.00	2.60	2.40	2.00	3.00	-	-	-	2.80	2.20	1.80	2.60	2.80	1.80	2.20	

ELECTIVE III

Semester VI

24153E64AP- PRINCIPLES OF MANAGEMENT 4 0 0 4

OBJECTIVE

i. To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management.
ii. To understand the statistical approach for quality control.
iii. To create an awareness about the ISO and QS certification process and its need for the industries

UNIT I HISTORICAL DEVELOPMENT 12

Definition of Management – Science or Art – Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Types of Business Organisation.

UNIT II PLANNING 12

Nature & Purpose – Steps involved in Planning – Objectives – Setting Objectives – Process of Managing by Objectives – Strategies, Policies & Planning Premises- Forecasting – Decision-making.

UNIT III ORGANISING 12

Nature and Purpose – Formal and informal organization – Organization Chart – Structure and Process – Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process - Techniques – HRD – Managerial Effectiveness.

UNIT IV DIRECTING 12

Scope – Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques –Job Enrichment – Communication – Process of Communication – Barriers and Breakdown –Effective Communication – Electronic media in Communication.

UNIT V CONTROLLING 12

System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology in Controlling – Use of computers in handling the information – Productivity – Problems and Management – Control of Overall Performance – Direct and Preventive Control – Reporting – The Global Environment – Globalization and Liberalization – International Management and Global theory of Management.

TOTAL = 60

COURSE OUTCOMES

- Basic Knowledge on management, business, organization culture, environment and planning process.
- Ability to organize business activities, motivational techniques and effective communication.
- Ability to understand the management control and budgetary techniques.

TEXT BOOKS

1. Harold Kooritz & Heinz Weihrich "Essentials of Management", Tata Mcgraw Hill,1998.
2. Joseph L Massie "Essentials of Management", Prentice Hall of India, (Pearson) Fourth Edition, 2003.

REFERENCE BOOKS

1. Tripathy PC And Reddy PN, " Principles of Management", Tata Mcgraw Hill,1999.
2. Decenzo David, Robbin Stephen A, "Personnel and Human Reasons Management", Prentice Hall of India, 1996.
3. JAF Stomer, Freeman R. E and Daniel R Gilbert Management, Pearson Education, Sixth Edition, 2004.
4. Fraidoon Mazda, " Engineering Management", Addison Wesley,-2000.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3		-	-	-	1	-	-	-	-	-	-	2	1	1
2	-	1	1	-	-	-	-	-	-	-	-	-	2	1	-
3	1		-	2	-	-	1	-	2	-	1	1	-	-	2
4	-	1	1	1	2	-	-	1	2	-	-	-	1	1	1
5	1		-	-	1	1	-	-	-	3	-	1	1	-	1
AVg.	1.66	1	1	1.5	1.5	1	1	1	2	3	1	1	1.5	1	1.25

ELECTIVES-III
SEMESTER VI

24153E64BP- MICRO ELECTRO MECHANICAL SYSTEMS 4 0 0 4

AIM :

To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.

To educate on the rudiments of Micro fabrication techniques.

To introduce various sensors and actuators

To introduce different materials used for MEMS

To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT I INTRODUCTION 9

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis –
Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I 9

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.

UNIT III SENSORS AND ACTUATORS-I 9

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements –Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators –
piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING 9

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching –Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process..

UNIT V POLYMER AND OPTICAL MEMS 9

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

Total = 45

COURSE OUTCOMES

Ability to understand the operation of micro devices, micro systems and their applications.

Ability to design the micro devices, micro systems using the MEMS fabrication process.

TEXT BOOKS

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCE BOOKS

1. Nadim Maluf,"An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

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MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	2	2	1	-	-	-	-	-	-	-	2	1	3
CO2	2	3	3	2	2	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	-	2	1	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	1	3	2
CO5	3	3	1	2	1	-	-	-	1	-	-	-	2	2	3
Avg	2.4	3	2.4	2.4	2	-	-	-	1	-	-	-	1.8	1.8	2.6

ELECTIVES-III SEMESTER-VI

24153E64CP INTEGRATED OPTO-ELECTRONIC DEVICES

3 1 0 4

AIM

To learn different types of optical emission, detection, modulation and opto electronic integrated circuits and their applications.

OBJECTIVE

- To know the basics of solid state physics and understand the nature and characteristics of light.
- To understand different methods of luminescence, display devices and laser types and their applications.
- To understand different light modulation techniques and the concepts and applications of optical switching.

UNIT I: ELEMENTS OF LIGHT AND SOLID STATE PHYSICS 9

Wave nature of light, Polarization, Interference, Diffraction, Light Source, review of Quantum Mechanical concept, Review of Solid State Physics, Review of Semiconductor Physics and Semiconductor Junction Device.

UNIT II: DISPLAY DEVICES AND LASERS 9

Introduction, Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, Injection Luminescence, LED, Plasma Display, Liquid Crystal Displays, Numeric Displays, Laser Emission, Absorption, Radiation, Population Inversion, Optical Feedback, Threshold condition, Laser Modes, Classes of Lasers, Mode Locking,laserapplications.

UNIT III: OPTICAL DETECTION DEVICES 9

Photo detector, Thermal detector, Photo Devices, Photo Conductors, Photo diodes, Detector Performance.

UNIT IV OPTOELECTRONIC MODULATOR 9

Introduction, Analog and Digital Modulation, Electro-optic modulators, Magneto Optic Devices, Acoustoptic devices, Optical, Switching and Logic Devices.

UNIT V OPTOELECTRONIC INTEGRATED CIRCUITS 9

Introduction, hybrid and Monolithic Integration, Application of Opto Electronic Integrated circuits, integrated transmitters and Receivers, Guided wave devices.

COURSE OUTCOMES

- Ability to understand and analyze Instrumentation systems and their applications to various industries.
- Ability to know the basic properties of laser and to apply for industry.
- Recognize the importance of laser in medicinal and industry applications.

TEXTBOOK

1. J. Wilson and J.Haukes, "Opto Electronics – An Introduction", Prentice Hall of India Pvt.
Ltd.,NewDelhi,1995.

REFERENCES

1. Bhattacharya "Semiconductor Opto Electronic Devices", Prentice Hall of India Pvt., Ltd., NewDelhi,1995.
2. Jasprit Singh, "Opto Electronics – As Introduction to materials and devices", McGraw- Hill International Edition, 1998.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	-	1	1	-	-	-	-	1	-	-	-
2	2	-	-	1	-	2	2	-	-	-	-	-	-	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
4	3	1	1	-	-	1	2	-	-	-	-	-	-	-	-
5	3	1	2	1	-	2	2	-	-	-	-	2	-	-	-
Avg.	2.8	1.3	1.6	1	-	1.5	1.8	-	-	-	-	1.5	-	-	-

24153E64DP -COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS

3 1 0 4

AIM

To introduce the basics of Computer Aided Design technology for the design of Electrical
Machines.

OBJECTIVE

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

Learn the importance of computer aided design method.

Understand the basic electromagnetic field equations and the problem formulation for CAD applications.

Become familiar with Finite Element Method as applicable for Electrical Engineering.

Know the organization of a typical CAD package.

Apply Finite Element Method for the design of different Electrical apparatus.

UNIT I: INTRODUCTION **12**

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 **12**

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 **12**

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

UNIT IV: CAD PACKAGES **12**

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

UNIT V: DESIGN APPLICATIONS **12**

Voltage Stress in Insulators – Capacitance calculation - Design of Solenoid Actuator – Inductance and force calculation – Torque calculation in Switched Reluctance Motor.

COURSE OUTCOMES

- The students will obtain the knowledge of basic electric and magnetic materials and design of rotating electrical Machines and Transformers.
- The students will be able to overall design the machines and transformers.

- The students will gain knowledge about the various types of electrical machines and design of both ac & dc Machines and many application.

TEXT BOOKS

1. S.J Salon, 'Finite Element Analysis of Electrical Machines', Kluwer Academic Publishers, London, 1995.
2. Nicola Bianchi, 'Electrical Machine Analysis using Finite Elements', CRC Taylor& Francis, 2005.

REFERENCES

1. Joao Pedro, A. Bastos and Nelson Sadowski, 'Electromagnetic Modeling by Finite Element Methods', Marcell Dekker Inc., 2003.
2. P.P.Silvester and Ferrari, 'Finite Elements for Electrical Engineers', Cambridge University Press, 1983.
3. D.A.Lowther and P.P Silvester, 'Computer Aided Design in Magnetics', Springer Verlag, New York, 1986.
4. S.R.H.Hoole, 'Computer Aided Analysis and Design of Electromagnetic Devices', Elsevier, New York, 1989.
5. User Manuals of MAGNET, MAXWELL & ANSYS Softwares.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3		-	-	-	1	-	-	-	-	-	-	2	1	1
2	-	1	1	-	-	-	-	-	-	-	-	-	2	1	-
3	1		-	2	-	-	1	-	2	-	1	1	-	-	2
4	-	1	1	1	2	-	-	1	2	-	-	-	1	1	1
5	1		-	-	1	1	-	-	-	3	-	1	1	-	1
AVg.	1.66	1	1	1.5	1.5	1	1	1	2	3	1	1	1.5	1	1.25

24153E64EP ADVANCED DC-AC POWER CONVERSION 2 0 2 4

AIM

To study advanced DC-AC power conversion technologies

OBJECTIVE

To provide conceptual knowledge in modern power electronic converters and its applications in electric power utility.

UNIT-I TWO-LEVEL VOLTAGE SOURCE INVERTER 9

Introduction - **Sinusoidal PWM** - Modulation Scheme - Harmonic Content – Over-modulation – Third Harmonic Injection PWM - **Space Vector Modulation** - Switching States - Space Vectors - Dwell Time Calculation - Modulation Index - Switching Sequence - Spectrum Analysis - Even-Order Harmonic Elimination - Discontinuous Space Vector Modulation

UNIT-II CASCADED H-BRIDGE (CHB) MULTILEVEL INVERTERS 9

Introduction - **H-Bridge Inverter** - Bipolar Pulse-Width Modulation - Unipolar Pulse-Width Modulation –**Multilevel Inverter Topologies -** CHB Inverter with Equal dc Voltage - H-Bridges with Unequal dc Voltages.

Carrier Based PWM Schemes - Phase-Shifted Multicarrier Modulation - Level-Shifted Multicarrier Modulation - Comparison Between Phase- and Level-Shifted PWM Schemes - Staircase Modulation.

UNIT-III DIODE-CLAMPED MULTILEVEL INVERTERS 9

Introduction -**Three-Level Inverter** - Converter Configuration - Switching State - Commutation - Space Vector Modulation - Stationary Space Vectors - Dwell Time Calculation - Relationship Between *Vref* Location and Dwell Times - Switching Sequence Design -Inverter Output Waveforms and Harmonic Content - Even-Order Harmonic Elimination - **Neutral-Point Voltage Control** - Causes of Neutral-Point Voltage Deviation – Effect of Motoring and Regenerative Operation - Feedback Control of Neutral-Point Voltage

UNIT-IV 9

Other Space Vector Modulation Algorithms - Discontinuous Space Vector Modulation - SVM Based on Two-level Algorithm **High-Level Diode-Clamped Inverters** - Four- and Five-Level Diode-Clamped Inverters - Carrier-Based PWM– **Other Multilevel Voltage Source Inverters – Introduction - NPC/H-Bridge Inverter - Inverter** Topology - Modulation Scheme - Waveforms and Harmonic Content - **Multilevel Flying-Capacitor Inverters** – Inverter Configuration - Modulation Schemes

UNIT-V PWM CURRENT SOURCE INVERTERS 9

Introduction - PWM Current Source Inverter - Trapezoidal Modulation - Selective Harmonic Elimination -**Space Vector Modulation** - Switching States - Space Vectors - Dwell Time Calculation - Switching Sequence -Harmonic Content - SVM Versus TPWM and SHE - **Parallel Current Source Inverters** - Inverter Topology -Space Vector Modulation for Parallel Inverters - Effect of Medium Vectors on dc Currents - dc Current Balance Control - Load-Commutated Inverter (LCI) **Total: 45**

TEXT/REFERENCE BOOKS:

1. B. Woo, "High Power Converters and AC Drives", John Wiley & Sons, 2006
2. Ned Mohan et.al , "Power Electronics" ,John Wiley and Sons,2006
3. Rashid, "Power Electronics, Circuits Devices and Applications", Pearson Education, 3rd edition, 2004.

4. G.K.Dubey, Thyristorised Power Controllers, Wiley Eastern Ltd, 1993.
5. Dewan & Straughen, Power Semiconductor Circuits, John Wiley & Sons, 1975.
6. Cyril W Lander, Power Electronics, Mc Graw Hill, 3rd edition, 1993.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	-	-	1	-	-	-	2	3	3	2
CO2	3	2	2	3	3	-	-	1	-	-	-	2	3	3	2
CO3	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
CO4	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
CO5	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
CO6	3	2	2	3	3	-	-	1	-	-	-	2	3	3	3
Avg	3	2	2	3	3	-	-	1	-	-	-	2	3	3	2

24153E74AP - POWER SYSTEM TRANSIENTS

3 0 0 3

Semester VII

AIM

To understand generation of switching and lighting transients, their propagation, reflection and refraction a on the grid ad their impact on the grid equipment.

OBJECTIVES

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

UNIT I INTRODUCTION AND SURVEY 7

Various types of power system transients - effects of transients on power systems.

UNIT II LIGHTNING AND SWITCHING SURGES 19

Electrification of thunder clouds – lightning current surges, parameters – closing and reclosing of lines – load rejection – fault clearing – short line faults – ferro-resonance – temporary over voltages – harmonics.

UNIT III MODELLING OF POWER SYSTEM EQUIPMENT 14

Surge parameters of power systems equipment, equivalent circuit representation, lumped and distributed circuit transients.

UNIT IV COMPUTATION OF TRANSIENT OVERVOLTAGES 14

Computation of transients – traveling wave method, Bewley's lattice diagram – analysis in time and frequency domain, EMTP for transient computation.

UNIT V INSULATION COORDINATION 12

Insulation co-ordination – over voltage protective devises principles of recent co-ordination and design of EHV lines. **Total = 60**

COURSE OUTCOMES

- Ability to understand and analyze power system transients and types of switching transients.
- To get knowledge about lightening transients and high voltage transient behavior travelling on line.
- To get knowledge about transients in integrated power systems.

TEXT BOOKS

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter science, New York, 2nd edition 1991**.**
2. R.D Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.

REFERENCES

1. Klaus Ragaller, 'Surges in High Voltage Networks', Plenum Press, New York, 1980.
2. Diesengrof, W., 'Overvoltages on High Voltage Systems', Rensealer Bookstore, Troy, New York, 1971.

MAPPING OF COs WITH POs AND PSOs

	POs												PSOs		
COs	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
CO2	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
CO3	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
CO4	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
CO5	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
Avg	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3

24153E74BP -EHV AC and DC TRANSMISSION SYSTEMS

3 0 0 3

UNIT I TRANSMISSION ENGINEERING 9

Transmission line trends – Standard transmission voltages – Power handling capacity and line losses Cost of transmission lines and equipment – Mechanical consideration – Transmission Engineering principles.

UNIT II LINE PARAMETER 9

Calculation of line and ground parameters - Resistance, capacitance and Inductance calculation – Bundle conductors – modes propagation – Effect of earth.

UNIT III POWER CONTROL 9

Power frequency and voltage control – voltage control – Over voltages – Power circle diagram – Voltage control using shunt and series compensation – Static VAR compensation – Higher Phase order system – FACTs.

UNIT IV EHV AC Transmission 9

Design of EHV lines based in steady state limits and transient over voltages – Design of extra HV cable transmission – XLPE cables – Gas insulated cable – Corona and RIV.

UNIT V HVDC TRANSMISSION 9

HVDC Transmission principles – Comparison of HVAC and HVDC transmission – Economics – types of Converters – HVDC links – HVDC control – Harmonics – Filters – Multi terminal DC System – HVDC cables and HVDC circuit breakers.

Total=45

COURSE OUTCOMES

- Basic knowledge of HVDC Transmission, its components, types and applications
- Ability to analyze and design the Converter circuits, System Control Techniques
- Ability to design filters for harmonic control and perform power flow analysis using Per unit system for DC Quantities.

Reference Books:

1. Rakosh Das Begamudre, 'Extra HVDC Transmission Engineering', Wiley Eastern Ltd, 1990.
2. Padiyar K.R., 'HVDC Power Transmission systems', Wiley Eastern Ltd, 1993.
3. Allan Greenwood, 'Electrical transients in power Systems', John Eastern Ltd, New York, 1992.
4. Arrilaga J., 'HVDC transmission', Peter Perengrinus Ltd, London, 1983.

MAPPING OF COs WITH POs AND PSOs

	POs												PSOs		
COs	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
CO2	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
CO3	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
CO4	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
CO5	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3
Avg	3	3	3	3	2	-	2	-	-	-	-	3	3	3	3

ELECTIVES-IV
SEMESTER-VII

24153E74CP - Fundamentals of Nanoscience 3 0 0 3

OBJECTIVES:

To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION 9

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thin films multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic,

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-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.

UNIT III NANOMATERIALS 9

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nano alumina, CaO, AgTiO2, Ferrites, Nano clays functionalization and applications- Quantum wires, Quantum dots-preparation, properties and applications..

UNIT IV 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.

UNIT V APPLICATIONS 9

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

L= 45 Total = 45

COURSE OUTCOMES

Will familiarize about the science of nanomaterials

Will demonstrate the preparation of nanomaterials

Will develop knowledge in characteristic nanomaterial

TEXT BOOKS

1. A.S. Edelstein and 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.

REFERENCE BOOKS

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

CO's- PO's & PSO's MAPPING

Course Outcomes	Statement	Program Outcome														
		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	understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications	2	3	2	3	3	-	-	-	1	1	-	3	1	1	3
CO2	acquire knowledge about the different types of nano material synthesis	2	3	1	3	3	-	-	-	1	1	-	3	2	1	3
CO3	describes about the shape, size,structure of composite nano materials and their interference	2	2	2	3	3	1	1	-	1	1	-	3	2	1	3
CO4	understand the different characterization techniques for nanomaterials	2	2	1	3	3	1	1	1	1	-	1	3	1	1	3
CO5	develop a deeper knowledge in the application of nanomaterials in different fields	2	2	1	3	3	1	1	1	1	-	1	3	2	1	3
	Overall CO	3	2	2	1	3	3	1	1	1	1	1	1	3	2	1

24153E74DP - ADVANCED CONTROL SYSTEMS 3 0 0 3

AIM

To gain knowledge in analysis of non-linear system and digital control of linear system.

OBJECTIVES

i. To study the description and stability of non-linear system.
ii. To study the conventional technique of non-linear system analysis.
iii. To study the analysis discrete time systems using conventional techniques.
iv. To study the analysis of digital control system using state-space formulation.
v. To study the formulation and analysis of multi input multi output (MIMO) system.

UNIT I NON-LINEAR SYSTEM – DESCRIPTION & STABILITY 9

Linear vs non-linear – Examples – Incidental and Intentional – Mathematical description - Equilibria and linearisation - Stability – Lyapunov function – Construction of Lyapunov function.

UNIT II PHASE PLANE AND DESCRIBING FUNCTION ANALYSIS 9

Construction of phase trajectory – Isocline method – Direct or numerical integration – Describing function definition – Computation of amplitude and frequency of oscillation.

UNIT III Z-TRANSFORM AND DIGITAL CONTROL SYSTEM 9

Z transfer function – Block diagram – Signal flow graph – Discrete root locus – Bode plot.

UNIT IV STATE-SPACE DESIGN OF DIGITAL CONTROL SYSTEM 9

State equation – Solutions – Realization – Controllability – Observability – Stability Jury's test.

UNIT V MUTLI INPUT MULTI OUTPUT (MIMO) SYSTEM:

9

Models of MIMO system – Matrix representation – Transfer function representation – Poles and Zeros – Decoupling – Introduction to multivariable Nyquist plot and singular values analysis – Model predictive control. **L = 45 Total = 45**

COURSE OUTCOMES

- Develop mathematical models and understand the mathematical relationships between
- the sensitivity functions and how they govern the fundamentals in control systems.
- Design and fine tune PID controllers and understand the roles of P, I and D in feedback control and develop state-space models

- Advanced filters design for various control applications with proper error estimation techniques.

TEXT BOOKS

1. Benjamin C. Kuo, 'Digital Control Systems', Oxford University Press, 1992.
2. George J. Thaler, 'Automatic Control Systems', Jaico Publishers, 1993.

REFERENCE BOOKS

1. I.J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2003.
2. Raymond T. Stefani & Co., 'Design of feed back Control systems', Oxford University, 2002.
3. William L. Luyben and Michael L. Luyben, 'Essentials of Process Control', McGraw Hill International Editions, Chemical Engineering Series, 1997.

CO's- PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	3	-	3	2	-	-	-	-		3	-	-	1
2	3	-	3	-	-	2	-	-	-	-		3	-	3	-
3	3	3	-	-	3	2	-	-	-	-		3	2	-	-
4	3	3	-	-	3	2	-	-	-	-		3	-	3	1
5	3	3	-	3	3	2	-	-	-	-		3	-	3	1
CO	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**	**1**

24153E74EP SWITCHED MODE POWER SUPPLIES 2 0 2 4

AIM

To study low power SMPS and UPS technologies

OBJECTIVE

To provide conceptual knowledge in modern power electronic converters and its applications in electric power utility.

UNIT-I Introduction 9

Linear regulator Vs. Switching regulator – Topologies of SMPS – isolated and non isolated topologies – Buck – Boost – Buck boost – Cuk – Polarity inverting topologies – Push pull and forward converters half bridge and full bridge – Fly back converters Voltage fed and current fed topologies. EMI issues.

UNIT-II Design Concepts 9

Magnetic Circuits and design – Transformer design - core selection – winding wire selection – temperature rise calculations - Inductor design. Core loss – copper loss – skin effect - proximity effect. Power semiconductor selection and its drive circuit design – snubber circuits. Closing the feedback loop – Control design – stability considerations

UNIT-III Control Modes 9

Voltage Mode Control of SMPS.. Transfer Function and Frequency response of Error Amp. Transconductance Error Amps. PWM Control ICs (SG 3525,TL 494,MC34060 etc.) Current Mode Control and its advantages. Current Mode Vs Voltage Mode. Current Mode PWM Control IC(eg.UC3842).

UNIT-IV Applications of SMPS 9

Active front end – power factor correction – High frequency power source for fluorescent lamps - power supplies for portable electronic gadgets.

UNIT-V Resonant converters 9

Principle of operation – modes of operation – quasi resonant operation- advantages.

Total : 45

Text/Reference Books:

1. Abraham I Pressman - Switching power supply design – 2nd edition 1998 Mc-Graw hill Publishing Company.
2. Keith H Billings - Switch mode power supply handbook – 1st edition 1989 Mc-Graw hill Publishing Company.
3. Sanjaya Maniktala - Switching power supplies A to Z. – 1st edition 2006, Elsevier Inc.
4. Daniel M Mitchell : DC-DC Switching Regulator Analysis. McGraw Hill Publishing Company
5. Ned Mohan et.al : Power Electronics. John Wiley and Sons.
6. Otmar Kilgenstein : Switched Mode Power Supplies in Practice. John Wiley and Sons.
7. Mark J Nave : Power Line Filter Design for Switched-Mode Power Supplies. Van Nostrand Reinhold, New York.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	3	3	-	2	-	3	3	3	3
CO2	3	3	3	3	-	-	3	3	-	2	-	3	3	3	3
CO3	3	3	3	3	-	-	3	-	-	3	-	3	3	3	3
CO4	3	3	3	3	-	-	-	-	-	2	-	3	3	3	3
CO5	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
CO6	3	3	3	3	-	-	3	3	-	3	-	3	3	3	3
Avg	3	3	3	3	-	-	3	3	-	2.5	-	3	3	3	3

24153P75P Project Work

- The student will use their ability to design electrical, electronic systems and signals through modeling, simulation, experimentation, interpretation and analysis to build, test, and debug prototype circuits and systems and analyze results using the principles of design to solve open-ended engineering problems.
- The students will be able to take professional decisions based on the impact of socio- economic issues by their self-confidence, a high degree of personal integrity, and the belief that they can each make a difference by developing persuasive communication skills in a variety of media by engaging them in team-based activities, and by strengthening their interpersonal skills. This will lead to develop the leadership qualities by making the students to identify their personal values and demonstrate the practice of ethical leadership.
- The students will be able to appreciate the importance of optimization, commercialization, and innovation as the desired features of the designed system

24153E44GP POWER ELECTRONICS FOR RENEWABLEENERGY SYSTEMS

COURSE OBJECTIVES: **3 0 0 3**

- To learn the various types of renewable sources of energy.
- To understand the electrical machines to be used for wind energy conversion systems.
- To learn the principles of power converters used in solar PV system.
- To study the principle of power converters used in Wind system.
- To simulate the AC-DC, AC-AC Converters, Matrix Converters and PWM Inverters.

UNIT I INTRODUCTION TO RENEWABLE ENERGY SYSTEMS 9

Classification of Energy Sources – Importance of Non-conventional energy sources – Advantages and disadvantages of conventional energy sources - Environmental aspects of energy - Impacts of renewable energy generation on the environment - Qualitative study of renewable energy resources: Ocean energy, Biomass energy, Hydrogen energy, - Solar Photovoltaic (PV), Fuel cells: Operating principles and characteristics, Wind Energy: Nature of wind, Types, control strategy, operating area.

UNIT II ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS

Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT III POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS 9

Power Converters: Line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. Simulation of line commutated converters, buck/boost converters. Analysis: Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems, Grid integrated solar PV Systems - Grid Connection Issues.

UNIT IV POWER CONVERTERS FOR WIND SYSTEMS 9

Power Converters: Three-phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid-Interactive Inverters - Matrix converter.

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Diesel-PV, Wind-PV, Micro hydel-PV, Biomass-Diesel systems - Maximum Power Point Tracking (MPPT).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students should be able to:

CO1: Examine the available renewable energy sources.

CO2: Demonstrate the working principles of electrical machines and power converters used for wind energy conversion system

CO3: Demonstrate the principles of power converters used for solar PV systems

CO4: Examine the available hybrid renewable energy systems.

CO5: Simulate AC-DC converters, buck/boost converters, AC-AC converters and PWM inverters.

REFERENCES:

1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press,2009, 7th impression.
2. Rashid .M. H "Power electronics Hand book", Academic press,2nd Edition, 2006 4th Edition,2017
3. Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	2	-	-	-	-	-	-	-	-	3	-	2
CO2	3	2	3	3	-	-	-	-	-	-	-	-	3	3	3
CO3	3	2	3	3	2	-	-	-	-	-	-	-	3	3	3
CO4	3	2	3	3	-	-	-	-	-	-	-	-	3	3	3
CO5	3	2	3	3	2	-	-	-	-	-	-	-	3	3	3
Avg	3	2	3	2.8	2	-	-	-	-	-	-	-	3	3	2.8

24153E54EP	MULTILEVEL POWER CONVERTERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn multilevel topology (Symmetry & Asymmetry) with common DC bus link.
- To study the working of cascaded H Bridge, Diode Clamped and Flying Capacitor MLI.
- To study the working of MLI with reduced switch count.
- To simulate three level diode clamped MLI and three level flying capacitor based MLIwith resistive and reactive load
- To simulate the MLI with reduced switch count.

UNIT I MULTILEVEL TOPOLOGIES 9

Introduction – Generalized Topology with a Common DC bus – Converters derived from the generalized topology – symmetric topology without a common DC link – Asymmetric topology.

UNIT II CASCADED H-BRIDGE MULTILEVEL INVERTERS 9

Introduction -H-Bridge Inverter, Bipolar Pulse Width Modulation, Unipolar Pulse Width Modulation. Multilevel Inverter Topologies, CHB Inverter with Equal DC Voltage, H-Bridges with Unequal DC Voltages — PWM, Carrier-Based PWM Schemes, Phase-Shifted Multicarrier Modulation, Level- Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted PWM Schemes- Staircase Modulation

UNIT III DIODE CLAMPED MULTILEVEL CONVERTER 9

Introduction – Converter structure and Functional Description – Modulation of Multilevel converters – Voltage balance Control – Effectiveness Boundary of voltage balancing in DCMC converters –Performance results.

UNIT IVFLYING CAPACITOR MULTILEVEL CONVERTER 9

Introduction – Flying Capacitor topology – Modulation scheme for the FCMC – Dynamic voltagebalance of FCMC.

UNIT V MULTILEVEL CONVERTER WITH REDUCED SWITCH COUNT 9

Multilevel inverter with reduced switch count-structures, working principles and pulse generationmethods.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students should be able to:

CO1: Examine the different topologies of multilevel inverters (MLIs) with and without DC link capacitor.

CO2: Examine the performance of MLIs with Bipolar Pulse Width Modulation (PWM) UnipolarPWM Carrier-Based PWM Schemes Phase Level Shifted Multicarrier Modulation

CO3: Demonstrate the working principles of Cascaded H-Bridge MLI, diode clamped MLI,flying capacitor MLI and MLI with reduced switch count

CO4: Analyze the voltage balancing performance in Diode clamped MLI.

CO5: Simulate three level, capacitor clamed and diode clamped MLI with R and RL load.

CO6: Simulate MLI with reduced switch configuration using fundamental switching scheme

TEXT BOOKS:

1. Rashid M.H,"Power Electronics Circuits, Devices and Applications", Prentice Hall India,Third Edition, New Delhi, 2014 Pearson 4th edition.
2. Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla,"Multilevel Convertersfor Industrial Applications", CRC Press, 22-Jul-2013, 20171st Edition.
3. BinWu, Mehdi Narimani,High Power Converters and AC drives by IEEE press 2017, 2ndEdition.

REFERENCEBOOKS:

1. Thomas A. Lipo, Pulse Width Modulation for Power Converters: Principles and Practice, D.Grahame Holmes, John Wiley & Sons, Oct-2003, 1st Edition.
2. Fang Lin Luo, Hong Ye,Advanced DC/AC Inverters: Applications in Renewable Energy,CRC Press, 22-Jan-2013, 2017, 1st Edition.
3. Hani Vahedi, Mohamed Trabelsi, Single-DC-Source Multilevel Inverters, Springer, 2019, 1stEdition.
4. Ersan Kabalcı, Multilevel Inverters Introduction and Emergent Topologies, Academic Press Inc,2021, 1st Edition.
5. Iftekhar Maswood, Dehghani Tafti,Advanced Multilevel Converters and Applications in Grid Integration, Wiley, 2018, 1st Edition.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	-	-	2	1	-	3	-	3	3	3	3
CO2	3	2	2	3	-	-	2	1	-	3	-	3	3	3	3
CO3	3	2	2	3	-	-	2	1	-	3	-	3	3	3	3
CO4	3	3	3	3	-	-	2	1	-	3	-	3	3	3	3
CO5	3	3	3	3	3	-	2	1	-	3	-	3	3	3	3
CO6	3	3	3	3	3	-	2	1	-	3	-	3	3	3	3
Avg	3	2.5	2.5	3	3	-	2	1	-	3	-	3	3	3	3

24153E54GP **MACHINE MONITORING SYSTEM** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To make the students familiarize with the concept of condition-based maintenance for effective utilization of machines.
- To Impart the knowledge of artificial intelligence for machinery fault diagnosis.
- To give basic knowledge on vibration monitoring.
- To study the machinery vibrations using signal processing techniques.
- To provide knowledge on FMECA.

UNIT I INTRODUCTION TO MACHINE CONDITION MONITORING 9

Machinery condition monitoring - Present status - Fault prognosis - Future needs.

UNIT II MACHINERY MAINTENANCE 9

Maintenance strategies – Reactive, Preventive, and Predictive – Benefits of planned maintenance – Bath tub curve – Failure Modes Effects and Criticality Analysis (FMECA).

UNIT III INTRODUCTION TO MACHINERY VIBRATION AND MONITORING 9

Characteristics of Vibration systems – Mode shapes & operational deflection shapes – Experimental modal analysis – Principles of vibration monitoring – Machinery faults diagnosed by vibration analysis.

UNIT IV SIGNAL PROCESSING IN MACHINERY MONITORING 9

FFT analysis – Time domain analysis – Time-frequency analysis – Signal filtering – Cepstrumanalysis – Health condition of compressor & engine.

UNIT V MACHINE LEARNING FOR CONDITION MONITORING 9

Machine Learning: Feature extraction and feature selection methods – Feature reduction – Classification techniques – Case studies of condition monitoring in Nuclear plant components,Distillation column.

TOTAL:45 PERIODS

COURSE OUTCOMES:

CO1 Ability to identify the faults in machinery L1.

CO2 Choose the proper maintenance strategies and condition monitoring techniques for identification of failure in a machine L3.

CO3 Construct a classifier model for machine learning based fault diagnosis L5.

CO4 Predict the faulty component in a machine by analyzing the acquired vibrationsignals L2.

TEXT BOOKS:

1. Cornelius SchefferandPareshGirdhar, "Practical Machinery Vibration Analysis and Predictive Maintenance", Elsevier, 2004, 1st Edition.
2. A. R. Mohanty, "Machinery Condition Monitoring: Principles and Practices" , CRC Press,Taylor & Francis, 1st Edition, 2017.

REFERENCES:

1 Stephen Marsland, Machine Learning: An Algorithmic Perspective, 2nd Edition, 2014, CRC, Press.

2. Collacot, "Mechanical Fault Diagnosis and Condition Monitoring", Chapman- Hall, 1st Edition,2011.
3. Davies, "Handbook of Condition Monitoring – Techniques and Methodology", Springer, 1st Edition, 2011.
4. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, 3rd Edition 2011.
5. Ferdinand van der Heijden, Robert Duin, Dick de Ridder, David M. J. Tax, Classification, Parameter Estimation and State Estimation: An Engineering Approach Using MATLAB, John Wiley & Sons, 2nd Edition, 2017.

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	-	-	-	1	-	-		2	3	2	3
CO2	3	-	-	-	-	-	2	1	3	-	1	2	3	2	3
CO3	3	-	1	2	3	-	-	1		-	-	2	3	2	3
CO4	3	3	-	-	-	-	-	1	3	-	-	2	3	2	3
CO5	3	-	1	2	-	-	-	1		-	2	2	3	2	3
Avg	3	2.5	1	2	3	-	2	1	3	-	1.5	2	3	2	3

24153E74FP	INTELLIGENT CONTROL OF ELECTRIC VEHICLES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To design and drive the mathematical model of a BLDC motor and its characteristics
- To learn the different control schemes for BLDC motor
- To study the basics of fuzzy logic
- To study the FPGA & VHDL basics
- To implement fuzzy logic control of BLDC motor in real time

UNIT I MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR 6

Structure and Drive Modes - Basic Structure, General Design Method, Drive Modes. Mathematical Model, Differential Equations, Transfer Functions, State-Space Equations. Characteristics Analysis, Starting Characteristics, Steady-State Operation, Dynamic Characteristics, Load Matching Commutation Transients

UNIT II SPEED CONTROL FOR ELECTRIC DRIVES 6

Introduction -PID Control Principle, Anti windup Controller, Intelligent Controller. Vector Control. Control applied to BLDC motor-.

UNIT III FUZZYLOGIC 6

Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems, overview of fuzzy expert system-fuzzy decision making..

UNIT IV FPGA AND VHDL BASICS 6

Introduction – FPGA Architecture-Advantages-Review of FPGA family processors- Spartan 3, Spartan 6 and Spartan 7. VHDL Basics- Fundamentals-Instruction set-data type-conditional statements- programs like arithmetic, sorting, PWM generation, Speed detection.

UNIT V REAL TIME IMPLEMENTATION 6

Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of48 V BLDC motor using FPGA**.** .

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Design and simulate speed controller for induction motors in EV for both dynamic and steadystate performance
2. Simulate a fuzzy logic controller based energy storage system for EV.
3. Fuzzy logic control of BLDC motor using FPGA in real time

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

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

CO1: To design the mathematical model of a BLDC motor and to discuss about its characteristics

CO2: To demonstrate the PID control, ant windup controller, Intelligent Controller and Vector Control. Control applied to BLDC motor.

CO3: To illustrate the basics of fuzzy logic system

CO4: To describe the basics of VHDL & FPGA applied to control of EVs.

CO5: To design and implement of fuzzy logic control scheme for BLDC motor using FPGA in realtime.

REFERENCES:

1. Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid, Electric andFuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, Wiley 1st Edition 2018.
2. VHDL Primer, A (3rd Edition), Jayaram Bhasker, Prentice Hall, 1st Edition 2015.
3. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Third Edition" CRCPress, Taylor & Francis Group, 2021, 1st Edition.
4. Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, Xia Wiley 2012, 1st Edition.
5. M.N. Cirstea, A. Dinu, J.G. Khor,M. McCormick, Neural and Fuzzy Logic Control of Drivesand Power Systems, Newnes publications, 1st Edition, 2002.
6. Wei Liu, Hybrid Electric Vehicle System Modeling and Control, Wiley 2017, 2nd Edition

MAPPING OF COs WITH POs AND PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	1	-	-	-	2	3	-	-
CO2	3	-	2	-	-	-	-	1	-	-	-	2	3	3	3
CO3	3	-	2	-	-	-	-	1	-	-	-	2	3	-	-
CO4	3	-	2	-	-	-	-	1	-	-	-	2	3	-	-
CO5	3	-	3	3	3	-	-	1	-	-	-	2	3	3	3
Avg	3	-	2.2	3	3	-	-	1	-	-	-	2	3	3	3