P. A. COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

POLLACHI - 642 002.

REGULATION 2019 (CBCS)

M.E - POWER ELECTRONICS AND DRIVES

CURRICULA AND SYLLABI

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CREDITS			
			L	T	P	C
THEORY						
1	19PEFC01	Research Methodology and IPR	3	0	0	3
2	19PEFC02	Applied Mathematics for Electrical Engineering	3	1	0	4
3	19PEPC01	Modelling and Analysis of Electrical Machines	3	0	0	3
4	19PEPC02	Power Semiconductor Devices and Components	3	0	0	3
5	19PEPC03	Analysis of Power Converters	3	0	0	3
6	19PEACZX	Audit Course I	2*	0	0	0
PRACTICAL						
7	19PEPC04	Power Electronic Circuits and Power Quality Laboratory	0	0	3	1.5
TOTAL			**17**	**1**	**3**	**17.5**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CREDITS			
			L	T	P	C
THEORY						
1	19PEPC05	Solid State Drives	3	0	0	3
2	19PEPC06	Switched Mode Power Converters	3	0	0	3
3	19PEPC07	Digital Control for Power Electronic Applications	3	0	0	3
4	19PEPEXX	Professional Elective I	3	0	0	3
5	19PEPEXX	Professional Elective II	3	0	0	3
6	19PEACZX	Audit Course II	2*	0	0	0
PRACTICAL						
7	19PEPC08	Electric Drives Laboratory	0	0	3	1.5
TOTAL			**17**	**0**	**3**	**16.5**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CREDITS			
			L	T	P	C
THEORY						
1	19PEPEXX	Professional Elective III	3	0	0	3
2	19PEPEXX	Professional Elective IV	3	0	0	3
3	19$$OEXX	Open Elective	3	0	0	3
PRACTICAL						
4	19PEEE01	Project Phase I	0	0	20	10
TOTAL			**9**	**0**	**20**	**19**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CREDITS			
			L	T	P	C
PRACTICAL						
1	19PEEE02	Project Phase II	0	0	32	16
TOTAL			**0**	**0**	**32**	**16**

TOTAL CREDITS: 69

NOTE : * - NO CREDIT COURSE

FOUNDATION COURSES(FC)

S. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19PEFC01	Research Methodology and IPR	3	0	0	3
2	19PEFC02	Applied Mathematics for Electrical Engineering	3	1	0	4

PROFESSIONAL CORES (PC)

S. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19PEPC01	Modelling and Analysis of Electrical Machines	3	0	0	3
2	19PEPC02	Power Semiconductor Devices and Components	3	0	0	3
3	19PEPC03	Analysis of Power Converters	3	0	0	3
4	19PEPC04	Power Electronic Circuits and Power Quality Laboratory	0	0	3	1.5
5	19PEPC05	Solid State Drives	3	0	0	3
6	19PEPC06	Switched Mode Power Converters	3	0	0	3
7	19PEPC07	Digital Control for Power Electronic Applications	3	0	0	3
8	19PEPC08	Electric Drives Laboratory	0	0	3	1.5

PROFESSIONAL ELECTIVES (PE) – I

S. NO.	COURSE CODE	COURSE TITLE	CREDITS			
			L	T	P	C
1	19PEPE01	Modelling of Power Converters	3	0	0	3
2	19PEPE02	Advanced Electric Drives and Controls	3	0	0	3
3	19PEPE03	Modern Converters and Control Techniques	3	0	0	3
4	19PEPE04	Fuzzy and Neural Systems	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – II

S. NO.	COURSE CODE	COURSE TITLE	CREDITS			
			L	T	P	C
1	19PEPE05	Pulse Width Modulation for Power Converters	3	0	0	3
2	19PEPE06	Special Machines and Controllers	3	0	0	3
3	19PEPE07	Microcontroller Based System Design	3	0	0	3
4	19PEPE08	Digital Signal Processing and Control	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – III

S. NO.	COURSE CODE	COURSE TITLE	CREDITS			
			L	T	P	C
1	19PEPE09	High Voltage DC Transmission Systems	3	0	0	3
2	19PEPE10	Flexible AC Transmission Systems	3	0	0	3
3	19PEPE11	Power Electronic Applications to Power System	3	0	0	3
4	19PEPE12	Evolutionary Computation	3	0	0	3
5	19PEPE13	Insulation Materials and Testing for Industrial Applications	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – IV

S. NO.	COURSE CODE	COURSE TITLE	CREDITS			
			L	T	P	C
1	19PEPE14	Power Electronics in Wind and Solar Power Conversion	3	0	0	3
2	19PEPE15	Distributed Generations and Microgrid	3	0	0	3
3	19PEPE16	Electromagnetic Interference and Compatibility in System Design	3	0	0	3
4	19PEPE17	Computer Aided Design of Electrical Machines	3	0	0	3
5	19PEPE18	Modern Power Electronics for Traction Applications	3	0	0	3

LIST OF OPEN ELECTIVES(OE)

S. NO.	COURSE CODE	COURSE TITLE	CREDITS			
			L	T	P	C
1	19PEOE01	Energy Auditing	3	0	0	3
2	19PEOE02	Advanced Energy Storage Technology	3	0	0	3
3	19PEOE03	Virtual Instrumentation	3	0	0	3
4	19PEOE04	Distribution Automation System	3	0	0	3
5	19PEOE05	Power Quality Assessment and Mitigation	3	0	0	3
6	19CSOE06	Human Computer Interaction	3	0	0	3
7	19CSOE07	Pattern Recognition	3	0	0	3
8	19CSOE08	Artificial Intelligence and Machine Learning	3	0	0	3
9	19CSOE09	Computer Network Engineering	3	0	0	3
10	19CSOE10	Green Computing	3	0	0	3

LIST OF AUDIT COURSES(AC)

S. NO.	COURSE CODE	COURSE TITLE	CREDITS			
			L	T	P	C
1	19PEACZ1	English for Research Paper Writing	2	0	0	0
2	19PEACZ2	Disaster Management	2	0	0	0
3	19PEACZ3	Value Education	2	0	0	0
4	19PEACZ4	Constitution of India	2	0	0	0
5	19PEACZ5	Pedagogy Studies	2	0	0	0
6	19PEACZ6	Stress Management by Yoga	2	0	0	0
7	19PEACZ7	Personality Development Through Life Enlightenment Skills	2	0	0	0
8	19PEACZ8	Sanskrit for Technical Knowledge	2	0	0	0

CURRICULUM DESIGN

S.No	COURSE WORK SUBJECT AREA	No of Credits					Percentage
		I	II	III	IV	Total	
1.	Foundation Courses	7	0	0	0	7	10.14 %
2.	Professional Cores	10.5	10.5	0	0	21	30.44 %
3.	Professional Electives	0	6	6	0	12	17.39 %
4.	Employability Enhancement Courses	0	0	10	16	26	37.68 %
5.	Open Elective Courses	0	0	3	0	3	4.35 %
Total Credits		**17.5**	**16.5**	**19**	**16**	**69**	**100%**

19PEFC01 RESEARCH METHODOLOGY AND IPR SEMESTER I

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Definition and objectives of Research
- Quantitative methods for problem solving
- Data description and report writing

UNIT I : INTRODUCTION (9)

Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code

UNIT II : QUANTITATIVE METHODS FOR PROBLEM SOLVING (9)

Statistical Modeling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis.

UNIT III : DATA DESCRIPTION AND REPORT WRITING (9)

Tabular and graphical description of data: Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables, Relation between frequency distributions and other graphs, preparing data for analysis Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing.

UNIT IV : INTELLECTUAL PROPERTY (9)

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V : PATENT RIGHTS (9)

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students", Juta Academic, 1996.
2. Donald H.McBurney and Theresa White, "Research Methods", 9th Edition, CengageLearning, 2013.
3. RanjitKumar, "Research Methodology: A Step by Step Guide for Beginners", 4th Edition, 2014.
4. Dr. C. R. Kotharia and GauravGarg, "Research Methodology: Methods and Trends", New age international publishers, Third Edition, 2014.

COURSE OUTCOMES:

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

CO1: Develop research question.
CO2: Perform exhaustive literature survey.
CO3: Apply right problem solving methods.
CO4: Prepare data for analysis.
CO5: Write research report.

19PEFC02 APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERING **SEMESTER I**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To familiarize with numerical solutions of first order ordinary equation with one variable.
- To familiarize to solve nonlinear programming problems by various methods.
- To obtain the knowledge of constructing Fourier series and related applications.
- To acquire knowledge of probability distributions both discrete and continuous cases.
- To gain the knowledge of test of hypothesis applicable to small and large samples.

UNIT-I : NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Taylor's method – Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Predictor and corrector methods: Milne's and Adam Bashforth methods

UNIT-II : NON-LINEAR PROGRAMMING (9+3)

Formulation of Non-Linear Programming Problem-Constrained Optimization with Equality Constraints-Constrained Optimization with inequality Constraints-Saddle Point Problem-Graphical method of Non-linear Programming Problem involving only two variables-Kuhn-Tucker conditions with non-negative constraints.

UNIT-III : FOURIER SERIES (9+3)

Fourier Trigonometric Series: Periodic Function as Power Signals – Convergence Series-Even and Odd function-Cosine and Sine Series-Non–Periodic Function: Extension to other intervals-Power signals: Exponential Fourier Series Parseval's Theorem and Power Spectrum-Eigen Value Problems and Orthogonal Functions-Regular Strum-Loiuville Systems-Generalized Fourier Series.

UNIT-IV : RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS (9+3)

Random variables–Moments–Moment generating functions and their properties-Standard probability distributions-Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT-V : TEST OF HYPOTHESIS (9+3)

Large samples: Tests of means and proportions. Small samples: t-test, F-test, Chi Square test.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods

REFERENCE BOOKS:

1. Srimanthapal, Numerical Methods, Principles, Analyses and Algorithm,Oxford University Press,New Delhi, Ist Edition, 2009.
2. Kandasamy P, Thilagavathy K and Gunavathy K "Numerical Methods"S.Chand& Co, Ramnagar, New Delhi, Reprint 2013
3. Taha,H.A., Operations Research-An Introduction, Prentice Hall of India, 2003.
4. T.Veerarajan, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Ltd., New.Delhi 2015.
5. Gupta S.C and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 2015.
6. Veerarajan T., Probability and Random Processes (with Queueing Theory and Queueing Networks), McGraw Hill Education(India)Pvt Ltd., New Delhi, Fourth Edition 2016.
7. Taha,H.A., Operations Research-An Introduction, Prentice Hall of India, 2003.

COURSE OUTCOMES:

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

CO1: Solve numerically one dimensional differential equations with decimal accuracy.

CO2: Acquire fluency in solving nonlinear programming problems.

CO3: Understand how to form fourier series using euler formulae with applications.
CO4: Understand the random variables and the discrete and continuous probability distributions.
CO5: Understand testing hypothesis connected to small and large samples.

19PEPC01 MODELLING AND ANALYSIS OF ELECTRICAL MACHINES **SEMESTER I**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study about various reference frame theories and analyze the performance of Rotating DC and AC machine

UNIT-I : PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION (9)

Basic of magnetic circuits – General expression of stored magnetic energy – energy and force/Torque Equation – Singly and doubly excited systems – Linear and Non-linear magnetic systems – Analysis of magnetic circuits with air gap and permanent magnets.

UNIT-II : REFERENCE FRAME THEORY (9)

Static and rotating reference frames – Stationary circuit variables transformed to the arbitrary reference frame – Commonly used reference frame -Transformation of variables – Transformation between reference frames – Transformation of a balanced set – Balanced steady state phasor and voltage equations – Variables observed from several frames of reference.

UNIT-III : DC MACHINES (9)

Voltage and Torque Equations – Dynamic characteristics of permanent magnet and shunt DC motors – Time - domain block diagrams -State equations – Solution of dynamic characteristic by Laplace transformation.

UNIT-IV : INDUCTION MACHINES (9)

Voltage and Torque Equations – Transformation for rotor circuits – Voltage and torque Equations in reference frame variables – Analysis of steady state operation – Free acceleration characteristics – Dynamic performance for load and torque variations – Dynamic performance for three phase fault – Computer simulation in arbitrary reference frame.

UNIT-V : SYNCHRONOUS MACHINES (9)

Voltage and Torque Equation – Voltage Equation in arbitrary reference frame and rotor reference frame – Park equations – Rotor angle and angle between rotor – Steady state analysis – Dynamic performances for torque variations – Dynamic performance for three phase fault – Transient stability limit – Critical clearing time – Computer simulation.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Paul C.Krause, Oleg Wasyzczuk, Scott S, Sudhoff, “Analysis of Electric Machinery and Drive Systems”,JohnWiley&Sons,2013.
2. Krishnan.R, “Electric Motor Drives, Modeling, Analysis and Control”, Prentice Hall of India,2002.
3. Samuel Seely, “Eletromechanical Energy Conversion”, Tata McGraw Hill Publishing Co, 1962.
4. Fitzgerald.A.E, Charles Kingsley, Jr, and Stephan D, Umanx, “Electric Machinery”, Tata McGrawHill, 7th Edition, 2014.

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Revise the knowledge about principles of electromagnetic energy conversion.
CO2: Determine the transformations among various co-ordinate frame.
CO3: Construct machine models based on different reference frames.
CO4: Analyze steady state and dynamic performance of DC machine.
CO5: Analyze transient behaviour of AC machine for sudden variation in load and three phase fault.

19PEPC02 **POWER SEMICONDUCTOR DEVICES AND COMPONENTS** **SEMESTER I**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To explore the recent developments of power electronic components, topologies and EMC.

UNIT-I : POWER SEMICONDUCTOR DEVICES (9)
Introduction to switches – Power Semiconductor devices : Diodes, BJT, Thyristors, JFETs, IGBTs, MoSFETs - Advanced Silicon devices - Silicon HV thyristors, MCT, BRT & EST. - SiC devices - Gallium nitrate devices – Applications.
UNIT-II : PROTECTION AND DRIVER CIRCUITS (9)
Protection schemes for power semiconductor devices – Snubber design – Gate Driver circuits for Power semiconductor devices
UNIT-III : MAGNETIC MATERIALS (9)
Advances in reactive elements - Advanced magnetic material, technology and design (Powder ferrite, Amorphous, Planar designs) – losses in magnetic components – applications
UNIT-IV : CAPACITIVE MATERIALS (9)
Components of Capacitor – Types – Stresses in a capacitor - Advanced capacitive material, technology and designs (Multilayer chip capacitors, double layers for storage, Aluminum electrolytic) – applications
UNIT-V : THERMAL DESIGN (9)
Thermal engineering with EMI/EMC techniques - Advanced thermal solutions (fan cooled, liquid cooled, heat pipes, hybrid techniques) - EMC techniques (Conducted, Radiated emissions & Susceptibility), System design for EMC.
CONTACT PERIODS:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

1. Robert Perret, " Power Electronics Semiconductor devices", John Wiley and sons, 2009.
2. Andrzej M Trzynadlowski, Introduction to Modern Power Electronics, John Wiley and sons. Inc, New York, 1998
3. R D MiddleBrook& Slobodan CUK, 'Advances in Switched Mode Power Conversion', Vol I, II, & III, Tesla Co (optimum power conversion)
4. B. JayantBalinga, 'Advanced High Voltage Power Device Concepts', Springer New York 2011. ISBN 978 -1- 46140268-8
5. Wurth Electronics, "Trilogy of Magnetics, Design guide for EMI filter design in SMPS & RF circuits", 4th extended and revised edition

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Understand the principles of operation of power semiconductor devices.
CO2: Recognize recent developments in design aspects of reactive elements.

CO3: Find out solutions for thermal design.
CO4: Examine the EMI/EMC problems and devise solutions for simple power electronic circuits.
CO5: Use of power electronic components in the interdisciplinary demanding areas for sustainable development of Society.

19PEPC03 ANALYSIS OF POWER CONVERTERS SEMESTER I

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the working, performance and control techniques of power converters

UNIT-I : AC-DC CONVERTERS (9)

Introduction – Single phase and three phase half and fully controlled converters with R, RL and RLE loads - Continuous and discontinuous modes of operation - Inverter operation – performance parameters: harmonics, distortion and power factor – Effect of source impedance - Dual converter: operation and applications.

UNIT-II : DC-DC CONVERTERS (9)

Introduction – Buck, Boost and Buck-boost and Cuk converters: working, steady state analysis and closed loop control - Types of choppers: A, B, C, D and E – Forced commutated choppers - battery charging via DC-DC converter.

UNIT-III : AC VOLTAGE CONTROLLERS AND CYCLO CONVERTERS (9)

Introduction – Principles of phase and integral cycle control – Single and three phase AC voltage controllers with R and RL loads – AC chopper – Cyclo converter: operation of single and three phase step up and step down converters – Harmonics and power factor control – introduction to matrix converters.

UNIT-IV : DC-AC CONVERTERS (9)

Introduction – single phase and three phase (120^0 and 180^0 mode) square wave inverters – Fourier analysis of output voltage - Methods of voltage control: PWM (single pulse, multiple pulse and sine PWM techniques) - harmonics elimination: by PWM and stepped wave inverters – Current source inverters: single phase – Multilevel inverter.

UNIT-V : GATING CIRCUITS FOR CONVERTERS (9)

Introduction – gating circuit for single and three phase fully controlled converter – gating circuits for choppers: gating circuit for AC voltage controllers – Generation of PWM signals for inverter using microcontrollers.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. G.K.Dubey, S.R.Doradla., A.Joshi, R.M.K Shinha" Thyristorised Power Controllers",New Age International Pvt. Ltd., Delhi, 2nd Edition,2012.
2. M.H.Rashid, 'Power Electronics: Circuits, Devices and Application', Pearson, Education of India,2014.
3. P.S.Bimbhra, 'Power Electronics', Khanna Publishers, Delhi, 14th Edition, 2012.
4. M.D.Singh,Kanchandani, 'Power Electronics', Tata McGraw Hill ., Delhi, 2nd Edition, 2008.
5. Mohan, Undeland and Robbins, "Power Electronics: Converters, Applications and Design", John's Wiley and Sons, 2006.

COURSE OUTCOMES:

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

CO1: Understand the working of different topologies of power conversion circuits.
CO2: Analyze the working of converters in specific loads in various applications.
CO3: Design and develop control strategies for efficient operation of converters.
CO4: Implementation of algorithms in digital controllers.

19PEPC04 **POWER ELECTRONIC CIRCUITS AND POWER QUALITY LABORATORY** **SEMESTER I**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To study the characteristics of the power electronic devices and performance of converter circuits through simulation and hardware setup.

LIST OF EXPERIMENTS:

1. Single phase semi and fully controlled rectifier with R & RL Load
2. Three phase semi converter and full converter using R Load
3. Open loop and closed loop control of buck Converter using MATLAB.
4. Open loop and closed loop control of boost Converter using MATLAB.
5. Performance analysis of single phase VSI using sine PWM Techniques- measure output voltage THD and distortion factor.
6. Three phase square wave inverter- measure output voltage THD and distortion factor.
7. Single phase cyclo-converter
8. Single phase ac voltage regulator with R & RL load
9. Study of single phase power quality analyzer.
10. Study the effect of voltage sag on electrical equipment.
11. Study the voltage sag due to starting of large induction motor in MATLAB/PSIM.

CONTACT PERIODS:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:
CO1: Synthesize various power electronic converter circuits in software platform.
CO2: Realize the hardware prototype for power converters.
CO3: Design control structure for efficient operation of power converters.
CO4: Measure the performance parameters of power converters in order to find out solution.

19PEPC05 **SOLID STATE DRIVES** **SEMESTER II**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide the concepts and performance analysis of Electric drives and to identify their suitability for various applications.

UNIT-I : CONVENTIONAL AND CONVERTER CONTROL OF DC DRIVES **(8)**

Review of Conventional Control of DC DRIVES and Characteristics - Methods of braking of dc motors – Models and transfer function of series and separately excited dc motor – Multi quadrant

operation. Control of dc drives with single phase and three phase converters - Closed loop control- Dual converter fed dc motor.

UNIT-II : CHOPPER CONTROL OF DC MOTORS (10)

Steady state analysis of chopper controlled dc drives – Continuous and discontinuous current conduction modes–Dynamic state analysis- Control strategies- CLC and TRC strategies – Multi quadrant control – Closed loop control- Micro Computer implementation for drives.- Traction motors- Traction supply systems.

UNIT-III : VOLTAGE AND FREQUENCY CONTROLLED INDUCTION MOTOR DRIVES (9)

Introduction - Four quadrant control and closed loop operation of AC drives – Effect of non-sinusoidal supply on performance of induction motor: Stator voltage control using AC voltage controller- VSI and CSI driven induction motors: motoring, regenerative braking and closed loop operation – Constant Volts/Hz control: Constant slip speed control and air gap flux weakening control – Comparison of VSI and CSI fed drives.

UNIT-IV : ROTOR RESISTANCE CONTROL AND SLIP ENERGY RECOVERY SCHEMES (9)

Constant torque operation – static rotor resistance control – Principle of vector control – Direct vector control scheme – Indirect vector control scheme – Speed control of slip ring induction motor by injected emf - Torque slip characteristics – Static Kramer and Scherbius drives - sub synchronous and super synchronous operations - torque equation.

UNIT-V : SYNCHRONOUS MOTOR DRIVES (9)

Vector controlled PM synchronous motor drives – constant flux and Flux weakening speed control - Power factor control and self-control - closed loop operation - permanent magnet synchronous motor (Brushless excitation)

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Sen, P.C. “Thyristor DC Drives”, John Wiley and Sons, 1991.
2. Krishnan.R. “Electric Motor Drives- Modelling, Analysis and Control”, Pearson Education,2010.
3. Dubey,G.K. “Power Semiconductor Controlled Drives”, New York:Prentice Hall,1993.
4. Vedam Subramanyam, “Electric drives concepts and applications”, Tata McGraw Hill publishing company Ltd., II Edition, New Delhi, 2011.
5. Murphy, J.M.D, Turnbull, F.G. ‘Thyristor Control of AC Motors’, Pergamon press, Oxford, First Edition,1988.

COURSE OUTCOMES:

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

CO1: Summarize the concepts of conventional DC drive.
CO2: Analyze the performance of various semiconductor controlled DC drives.
CO3: Identify and enhance uses of dc drive in modern applications.
CO4: Analyze the performance of AC motors with various control strategies.
CO5: Implementation of AC drive systems.
CO6: Identify the suitability of control methods of AC Drives for industrial applications.

19PEPC06 SWITCHED MODE POWER CONVERTERS SEMESTER II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To comprehend the design and analysis of advanced power converter topologies for real time

applications.

UNIT-I : INTRODUCTION **(8)**

Switching devices - Ideal and real characteristics, control - Drive and protection - Design of inductor, Design of transformer - Capacitors for power electronic applications.

UNIT-II : DC-TO-DC CONVERTERS **(9)**

Basic concepts of Switched Mode power converters - Primitive DC to DC Power Converter Operating Principle - Exact and Approximate Analysis.

UNIT-III : CONVERTER TOPOLOGIES **(10)**

Non-isolated DC to DC Power Converter - Buck, Boost, Buck-Boost, Cuk, SEPIC and Quadratic Converters - Isolated DC to DC Power Converter - Forward, Fly back, Half/Full Bridge Converters. - Steady State model, dynamic model, analysis, modeling and performance functions of switching power converters.

UNIT-IV : RESONANT CONVERTERS **(8)**

Classification of resonant converters - Basic resonant circuit concepts, Load resonant converters – Resonant Switch converters - Zero voltage and Zero current switching.

UNIT-V : CLOSED LOOP CONTROL OF POWER CONVERTERS **(10)**

Closed Loop Control of Switching Converters- Steady State Error, Control Bandwidth, and Compensator Design - Closed Loop Dynamic Performance Functions - Design of feedback compensators - Unity power factor rectifiers - Resistor emulation principle - Applications to rectifiers

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

1. Robert W. Erickson, Dragan Maksimovic “Fundamentals of Power Electronics,” Springer, 2005.
2. Ramanarayanan V., “Course Material on Switched Mode Power Conversion”, Department of Electrical Engineering, Indian Institute of Science, Bangalore, 2007.
3. Issa Batarseh, ‘Power Electronic Circuits’, John Wiley, 2004.
4. Philip T Krei, “Elements of Power Electronics”, Oxford Press, 2nd edition 2015.
5. L.Umanand, “Power Electronics Essentials & Applications”, Wiley India Pvt. Ltd., 2009

COURSE OUTCOMES:

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

CO1: Design and selection of component values based on steady-state dc and ac ripple specifications.

CO2: Analyze existing power converter topologies.

CO3: Design new and efficient power converters suitable for specific applications.

CO4: Analysis and Design of Control Loops around switched-mode power converters using averaging small-signal dynamic models and classical control theory.

19PEPC07 **DIGITAL CONTROL FOR POWER ELECTRONIC APPLICATIONS** **SEMESTER II**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To explore the concepts and applications of digital control systems for power electronic circuits.

UNIT-I : DIGITAL CONTROL SYSTEMS **(9)**

Concepts of digital control - Structure of digital control system - Discrete time systems: Sampling and reconstruction of signals - ZOH circuits - Introduction to Z-transforms and inverse Z-

transforms – Modeling of digital control systems

UNIT-II : STABILITY OF DIGITAL CONTROL SYSTEMS AND DESIGN (9)

Stability conditions - Stability determination - Nyquist criterion - Phase margin and gain margin, Z-domain root locus - Z-domain P, PI, PID control design - Frequency response design – State space modelling of power converters.

UNIT-III : DIGITAL CONTROL APPLICATION IN POWER ELECTRONIC CIRCUITS (9)

Single phase inverter - Digital current mode control - Requirements of digital controller - Basic current control implementations: PI - Predictive controller Three Phase Systems: Space vector modulation - Rotating reference frame current controller - Design of rotating reference frame PI current controller.

UNIT-IV : EXTERNAL CONTROL LOOPS (9)

Modeling of internal control loops - Design of voltage controllers - Large band width controllers – Narrow band width controllers - Applications of current controllers.

UNIT-V : DESIGN OF FPGA AND DSP BASED SYSTEMS (9)

Introduction to Field Programmable Gate Arrays-types of FPGA-DSP Slices- Design example-Introduction to DSP - Modeling of DSP algorithms in MATLAB - conversion of MATLAB models into fixed point VHDL blocks - Platform implementation issues: FPGA vs DSP

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Simone Buso, paolo Mattavelli, "Digital control in power electronics", Morgan & Claypool Publishers, 2006.
2. M.SamFadali , "Digital control engineering analysis and design" Academic Press, 2012.
3. Ogata:K, "Modern Control Engineering"—Prentice Hall –2014.
4. B K Bose , "Modern Power Electronics and AC Drives" —Pearson Publications 1edition,2011.
5. Prof. Miguel Castilla (ed.), "Control Circuits in Power Electronics: Practical issues in design and implementation" IET, 2016.

COURSE OUTCOMES:

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

CO1: Understand the concept of digital control system and able to design and deal with the Z-domain representation of systems.

CO2: Test the real time system stability and design of control loops in digital domain.

CO3: Analyze the system dynamics with digital controllers.

CO4: Enrich knowledge for research studies in digital controller based power electronic systems.

19PEPC08 ELECTRIC DRIVES LABORATORY SEMESTER II

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To explore the performance of power converter fed drives by using simulation software microcontroller and DSP controllers.

LIST OF EXPERIMENTS:

1 Open and closed loop control of converter fed DC drive
2 Open and closed loop control of chopper fed DC drive
3 Speed control of AC voltage controller fed single phase inductor motor using MATLAB.
4 Constant V/f control of PWM inverter fed three phase induction motor (open and closed

loop)

5 Speed control of BLDC motor using PIC controller
6 Speed control of SRM drive using FPGA/PIC controller
7 Stator voltage control of three phase induction motor using MATLAB software
8 Vector control of three phase induction motor using MATLAB software
9 Regenerative braking operation of DC motor in PSIM/MATLAB software
10 Regenerative braking operation of induction motor in PSIM/MATLAB software

CONTACT PERIODS:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

CO1: Build and test various power electronic converters for drives
CO2: Analyze the performance of various drives using simulation software.
CO3: Realizing various control techniques for drives using microcontroller and DSP controllers
CO4: Ensure Energy Efficient operation of drives

19PEEE01 PROJECT PHASE I SEMESTER III

L	T	P	C
0	0	20	10

COURSE OBJECTIVES:

- To undertake detailed technical work in the chosen area of theoretical Engineering studies through simulations for the benefit of Society.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:
CO1: Identify the engineering problem based on societal/industrial demand through detailed literature Survey.
CO2: Design and evaluate the system using software tools.
CO3: Gain expertise in the interpretation of simulation / experimental, technical presentation and documentation.

CONTACT PERIODS:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 300 Periods Total: 300 Periods

19PEEE02 PROJECT PHASE II SEMESTER IV

L	T	P	C
0	0	32	16

COURSE OBJECTIVES:

- To undertake detailed technical work in the chosen area of theoretical Engineering studies through simulations for the benefit of Society.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:
CO1: Solve the Identified problem with cutting edge technologies.
CO2: Design and evaluate the system using software/ hardware tools to develop innovative outputs/ Products in terms of Journal publications/patents.
CO3: Gain expertise in the interpretation of simulation / experimental, technical presentation and documentation.

CONTACT PERIODS:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 480 Periods Total: 480 Periods

19PEPE01 MODELLING OF POWER CONVERTERS SEMESTER I

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn advanced modeling and control topics in power electronic converters

UNIT-I : MODELLING OF DC-DC CONVERTERS (9)

Review of ideal switch - Basic DC-DC converter topologies-Steady state analysis - DC transformer model - Construction of equivalent circuit model - Basic AC modelling approach - State-space averaging - Circuit averaging and average switched model - Canonical circuit model - Modelling of PWM modulator - Some examples.

UNIT-II : CONTROLLER DESIGN (9)

Review of bode plots - Analysis of converter transfer functions - Closed loop control: an introduction - Effect of negative feedback on the network transfer functions - Construction of the important quantities 1/(1 + T) and T/(1 + T) and the closed-loop transfer functions – Stability - Regulator design - PI,PD and PID compensators.

UNIT-III : CURRENT PROGRAMMED CONTROL (12)

AC and DC equivalent circuit modelling of the discontinuous conduction mode - Averaged switched model - Small-signal AC modelling of the DCM switch network - High frequency dynamics of converters in DCM-Oscillation for D >0.5 -Simple first-order model - More accurate model - Effects of current-programmed control on the converter transfer functions - Discontinuous conduction mode.

UNIT-IV : SPACE PHASORS AND TWO-DIMENSIONAL FRAMES (6)

Introduction - Space-phasor representation of a balanced three-phase function - Space-phasor representation of three-phase systems - Power in three-wire three-phase systems - αβ and dq-frame representation and control of three-phase signals and systems.

UNIT-V : TWO-LEVEL, THREE-PHASE VOLTAGE-SOURCED CONVERTER (9)

Introduction - Two-level voltage-sourced converter models and control of two level VSC: Averaged model of two-level VSC – Model and control of of two-level VSC in αβ and dq-Frame-Classification of VSC Systems.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Robert W. Erickson, Dragan Maksimovic "Fundamentals of Power Electronics," Springer, 2005.
2. AmirnaserYazdani,RezaIravani, "Voltage-Sourced Converters In Power Systems - Modeling, Control, And Applications", Wiley India Pvt. Ltd., 2010.
3. L.Umanand, "Power Electronics Essentials & Applications", Wiley India Pvt. Ltd., 2009.
4. M.H.Rashid, "Power Electronics: Circuits, Devices and Application", Pearson, Education of India, 2012.

COURSE OUTCOMES:

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

CO1: Review the basic concepts of DC-DC converter.

CO2: Ability to model power DC-DC Converters in order to obtain both small-signal and large-signal models.

CO3: Design the control loop compensator in order to stabilize single power converter.

CO4: Model the Voltage-Sourced Converter and to design closed loop control techniques.

19PEPE02 ADVANCED ELECTRIC DRIVES AND CONTROLS SEMESTER I

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study and analyze the performance of electric drives with modern controllers and techniques.

UNIT-I : INTRODUCTION (9)

Need for advanced controls - Principle factor affecting the choice of drive – Parameter identification techniques for electric motors – Electromagnetic compatibility of electric drives – Different options for an adjustable speed electric drive – Simulation of electrical drives – Advanced control strategies for electrical drives – DSP based control of electric drives.

UNIT-II : DSP CONTROLLERS AND INSTRUCTION SET (9)

TMS 320 family overview – 320 C24X Series of DSP controllers – Architecture – C24X CPU internal bus structure – Central processing unit – Memory and I/O spaces–Program control – Address modes – System configuration and interrupts – Clocks and low power modes –Digital input/output. Instruction set: Assembly language instructions – Instruction set and description – Accumulator, arithmetic and logic instructions – Auxiliary register and data page pointer instructions – TREG, PREG, Multiply instructions – Branch instructions – Control instructions – I/O and memory instructions.

UNIT-III : PWM INVERTER CONTROL (9)

Inverter – Operation principle – Inverter switching – Unipolar – Bipolar – Inverter dead time– Inverter modulation – Different types – Sine Triangle – Analysis of Sine Triangle Modulation – Trapezoidal Modulation – Third harmonic Modulation – Analysis of Third Harmonic Modulation – Output filter requirement for different PWM techniques.

UNIT-IV : SPACE VECTOR MODULATION (9)

Concept of a Space Vector – dq Components for Three-phase sine wave source–dq Components for Voltage Source Inverter operated in Square Wave Mode – Synchronously rotating reference frame – Space Vector Modulation – Principle – SVM compared to regular sampled PWM Phase Lag reference for SVM – Naturally sampled SVM – Analytical solution – Harmonic losses – Placement of Zero Space Vector – Discontinuous Modulation – Phase Lag reference for discontinuous PWM.

UNIT-V : ADVANCED CONTROLLERS (9)

Current and speed control of Induction Motor – Current control algorithm – Sensorless motion control strategy – Induction Motor Controller using VHDL design. Fuzzy Logic Control of a Synchronous Generator – System representation – VHDL Modelling – FPGA implementation.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Bimal K. Bose, “Power Electronics and Variable Frequency Drives – Technology and Applications”, IEEE Press, 1997.
2. Grafame Holmes.D and Thomas A. Lipo, “Pulse Width Modulation for Power Converters – Principles and Practice”, IEEE Press, 2003.
3. Peter Vas, “Vector Control of AC Machines”, Oxford University Press, 1990.
4. Hamid A. Toliyat and Steven G.Campbell, “DSP based Electromechanical Motion Control”, CRC Press 2004.

5. Ned Mohan, “Advanced Electric Drives: Analysis, Control and Modeling using SIMULINK”, John Wiley & Sons Ltd., 2001 .

COURSE OUTCOMES

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

CO1: Gain knowledge about DSP controllers for drive applications.

CO2: Analyze the performance of inverter for drives with various PWM techniques and neuro - fuzzy controllers.

CO3: Identify the suitability of techniques for different drive applications.

CO4: Expertise to enhance the performance of drives with modern controllers.

19PEPE03 MODERN CONVERTERS AND CONTROL TECHNIQUES **SEMESTER I**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To explore the new control techniques for power converters and put them into use in hardware controllers and techniques.

UNIT-I : CARRIER-BASED PULSE WIDTH MODULATION INVERTERS (9)

Overview of Three phase Inverters-Performance indices - Harmonic spectrum analysis - Modelling of three phase Inverters - Carrier Based Pulse Width Modulation Algorithms - Carrier-Based PWM Algorithms with Improved Reference - PWM Used within Volt/Hertz Drives - Implementation of Harmonic Reduction with carrier PWM - Limits of operation.

UNIT-II : VECTORIAL PWM FOR INVERTERS (9)

Review of Space Vector Theory - Vectorial Analysis of Three-Phase Inverter - SVM Theory - Derivation of the Time Intervals Associated to the Active and Zero States by Averaging - Adaptive SVM:DC Ripple Compensation - Link to Vector Control - Different Forms and Expressions of Time Interval Equations in the(d,q) Coordinate System - Definition of the Switching Reference Function- Definition of the Switching Sequence- Comparison between Different Vectorial PWM - Over modulation for SVM-Volt/Hertz Control of PWM Inverters - Practical Aspects in Building Three Phase Power Converters.

UNIT-III : PWM ALGORITHMS, CURRENT CONTROL AND COMPONENT MINIMISATION (10)

Analog Pulse Width Modulation Controllers - Mixed Mode Controller ICs-Digital Structures with Counters - FPGA Implementation - Software Implementation in Low cost Microcontrollers - Microcontrollers with Power Converter Interfaces-Motor Control Co-Processors- Practical Aspects of Implementing Closed Loop Current control - Minimized Three Phase Power Converters.

UNIT-IV : GRID INTERFACE AND PARALLEL POWER CONVERTERS (9)

Control Objectives and Active Power Control - PWM in Control System - Closed loop Current Control Methods - Grid Synchronization - Comparison between Converters Built of High Power Devices - Solutions based on Multiple Parallel Lower Power Devices - Hardware Constraints in Paralleling IGBTs - Gate Control Designs for Equal Current Sharing - Advantages and Disadvantages of Paralleling Inverter Legs - Interleaved operation of power converters - Circulating Currents - Selection of the PWM Algorithm - System Controller.

UNIT-V : IMPLEMENTATION OF MODULATION CONTROLLER (8)

Elements of PWM converter system - Hardware implementation of the PWM process - Continuing developments in Modulation - Random Pulse width Modulation – PWM rectifier with voltage unbalance - common Mode Elimination - Four Phase leg Inverter Modulation - Effect of Minimum Pulse width - PWM Dead time compensation.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Dorin O. Neacsu, "Power Switching Converters", CRCPress,Taylor& Francis, 2014
2. Grahame Holmes D. and Thomas A. Lipo, "Pulse width Modulation for Power Converters", IEEE Press series on Power Engineering, Wiley-Interscience, John Wiley&Sons,Inc., 2003.
3. Eric Monmasson, "Power Elesctronic Converrrters: PWM strategies and current control Techniques", Wiley – ISTE, 2013
4. Edison R.Silva, Euzeli dos Santos, "Advanced Power Electronic Converters: PWM Converters Processing AC Voltages", IEEE, Wiley, 2015.

COURSE OUTCOMES:

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

CO1: Adapt state of art PWM techniques to improve the performance of power converters.
CO2: Utilize various controllers to generate PWM signals.
CO3: Analyze and design of power converters with different modulation technique.
CO4: Articulate the practical aspects of implementing the control methods in hardware.

19PEPE04 FUZZY AND NEURAL SYSTEMS SEMESTER I

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge on Neural Networks and Fuzzy Logic Control and understand the use these for controlling real time systems.

UNIT-I : INTRODUCTION TO NEURAL NETWORKS (9)

Introduction – Biological and Artificial neural networks - Learning rules – Training - ADALINE - MADALINE – BAM – Discrete Hopfield networks .

UNIT-II : ARTIFICIAL NEURAL NETWORKS (9)

Theory, Architecture and Applications of Back propagation network – Counter propagation network – Kohenen's Self Organising Maps.

UNIT-III : INTRODUCTION TO FUZZY (9)

Fuzzy sets and membership – Chance Vs ambiguity – Classical sets – Fuzzy sets – Fuzzy relations – Tolerance and Equivalence relations – Value assignments.

UNIT-IV : FUZZIFICATION AND DEFUZZIFICATION (9)

Fuzzification – Membership value assignments – Fuzzy to Crisp conversions - Lambda – Cuts for Fuzzy sets and relations – Defuzzification methods. Simple Neuro – Fuzzy Controller.

UNIT-V : FUZZY ARITHMETIC, NUMBERS, VECTORS AND EXTENSION PRINCIPLE (9)

Extension principle – Fuzzy numbers – Interval analysis in arithmetic – Approximate methods of extension: Vertex method, DSW algorithm, Restricted DSW algorithm – Fuzzy vectors – Classical predicate logic – Approximate reasoning – Fuzzy tautologies, contradictions, Equivalence and Logical proofs.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Laurene Fausett, "Fundamentals of Neural Networks", Prentice Hall, New Jersey, 2004.

2. Timothy J.Ross, "Fuzzy logic with Engineering Applications", Wiley India Pvt. Ltd., 3rd Ed., 2010.
3. Kosko.B, "Neural Network and fuzzy systems"- Prentice Hall of India Pvt. Ltd., New Delhi, 2007.
4. S N Sivanandam., S N Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Ed., 2011.
5. Robert .J.Schalkoff, "Artificial Neural Networks", McGraw Hill, Singapore, 2011.

COURSE OUTCOMES:

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

CO1: Familiarize with the basic concepts of neural networks.
CO2: Learn about BAM and discrete Hopfield networks.
CO3: Master the functioning of back propagation network and Kohenen's self organizing map.
CO4: Familiarize with the concept of Fuzzy sets and able to differentiate crisp set and fuzzy sets.
CO5: Analyze fuzzification and Defuzzification. .
CO6: Comprehend Neuro-Fuzzy modelling

19PEPE05 PULSE WIDTH MODULATION FOR POWER CONVERTERS SEMESTER II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of Power converter topologies, PWM techniques and explore the steady-state, dynamic analysis of PWM converters along with the applications

UNIT-I : POWER CONVERTER TOPOLOGY (9)

AC-DC and DC-AC power conversion – Electronic switches – DC-DC buck and boost converters – H-bridge converter - multi level converters – diode clamp, flying capacitor and cascaded cell converters – Voltage source and current source converters.

UNIT-II : INTRODUCTION TO PWM (9)

Review of Fourier series – Need of PWM : fundamental and harmonic voltages - undesirable effects of harmonic voltages – line current distortion, increased losses, pulsating torque in motor drives; control of fundamental voltage - mitigation of harmonics and their adverse effects – Fundamental concept of Pulse Width Modulation – PWM at low switching frequency operation of VSI : One switching angle per quarter, two switching angles per quarter – Sine triangle PWM – Third harmonic injection PWM – Selective harmonic elimination and THD optimized PWM.

UNIT-III : PWM TECHNIQUES (9)

Bus Clamping PWM - Space vector based PWM – Comparison of PWM – Advanced PWM techniques - Space vector approach to over modulation – PWM to multilevel inverters

UNIT-IV : MODELLING AND ANALYSIS FOR PWM CONVERTERS (9)

Compensation for dead time and DC regulation – Dynamic model of a PWM converter , multilevel converters - analysis of line current ripple and torque ripple in inverter fed drives – line side converters with power factor compensation.

UNIT-V : APPLICATIONS OF PWM CONVERTERS (9)

DC Motor drive - Constant V/F induction motor drives - Active front end converters - Reactive compensators – Harmonic current compensation - active power filters

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Mohan, Undeland and Robbins, 'Power Electronics; Converters, Applications and Design', John Wiley and Sons, 1989.
2. Erickson R W, 'Fundamentals of Power Electronics', Chapman and Hall, 1997.
3. Vithyathil J, 'Power Electronics: Principles and Applications', McGraw Hill, 1995
4. Grahame Holmes and Thomas A.Lipo, "Pulse Width Modulation for Power Converters: Principle and Practice", IEEE Press, John Wiley and Sons,2003

COURSE OUTCOMES:

CO1: Understand the basic operations of various Power Converters Topology
CO2: Outline the fundamentals of PWM techniques and applying the real time systems
CO3: Explore the Steady-State, transient modelling and analysis of power converters with various PWM techniques.
CO4: Analysis and Design of Control Loops for PWM power converters
CO5: Use in Environment friendly applications like solid state drives and power quality in societal needs.

19PEPE06 SPECIAL MACHINES AND CONTROLLERS SEMESTER II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the construction, principles of operation, performance and control techniques of special machines

UNIT-I : SYNCHRONOUS RELUCTANCE MOTORS (9)

Constructional features - Axial and radial air gap Motors Operating principle, reluctance torque – Phasor diagram, motor characteristics.

UNIT-II : STEPPER MOTORS (9)

Constructional features - Principle of operation - Modes of excitation torque production in Variable Reluctance (VR) stepping motor - Dynamic characteristics, Drive systems and circuit for open loop control - Closed loop control of stepping motor - Applications.

UNIT-III : SWITCHED RELUTANCE MOTORS (9)

Constructional features - Principle of operation - Torque equation - Power Controllers - Characteristics and control - Microprocessor based controller - Applications of SRM.

UNIT-IV : PERMANENT MAGNET SYNCHRONOUS MOTORS (9)

Permanent Magnet and Characteristics - Principle of operation, EMF, power input and torque expressions - Phasor diagram - Power controllers - Torque speed characteristics – Self-control - Vector control - Current control schemes - Sensorless control - Applications of PMSM

UNIT-V : PERMANENT MAGNET BRUSHLESS DC MOTORS (9)

Commutation in DC motors - Difference between mechanical and electronic commutators - Hall sensors - Optical sensors - Multiphase Brushless motor - Square wave - Sine wave permanent magnet brushless motor drives, Torque and emf equation - Torque-speed characteristics – Microprocessor based controller – Applications of PMSM and BLDC in EV

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Miller, T.J.E. "Brushless permanent magnet and reluctance motor drives", Clarendon Press, Oxford University,1989.

2. Kenjo, T, “Stepping motors and their microprocessor control ", Clarendon Press, Oxford University, Second Edition, 2003.
3. Kenjo, T and Naganori, S “Permanent Magnet and brushless DC motors ", Clarendon Press, Oxford University, 1990.
4. Kenjo, T. “Power Electronics for the microprocessor Age’, Oxford University press, 1995
5. B.K. Bose, “Modern Power Electronics & AC drives”, Prentice Hall Publisher, 2012.
6. R.Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2010
7. Venkataratnam, “Special Electrical Machines”, Hyderabad university press, 2009.

COURSE OUTCOMES:

CO1: Acquire knowledge in the working of special machines and its performance.
CO2: Design the control algorithms for the special machines.
CO3: Implementation of control techniques in the digital controllers.
CO4: Comparison of suitability of machine for various applications.

19PEPE07 MICROCONTROLLER BASED SYSTEM DESIGN SEMESTER II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the basics of systems with specifications, architecture, design, control and implementation in real time applications.

UNIT-I PIC MICRO CONTROLLER –FRAME WORK (9)

PIC 16Cx/7x family and PIC 18F – Architecture - Program memory considerations-register file structure - CPU registers - Addressing modes - Instruction set -simple programs.

UNIT-II : REAL TIME CONTROL (10)

Interrupt structure - Interrupt logic -Interrupt service routine - Interrupt constraints - Critical regions – Shortening an interrupt handler -Timers -0-1-2 and uses – Timer External event counter - PWM outputs.

UNIT-III : PERIPHERALS OF PIC MICROCONTROLLER (8)

I2C bus for peripherals chip access- I2C Bus operation A/D converters- overview-ADC characteristics ADC use - UART wave forms and baud rate accuracy – UART data handling circuitry - UART uses.

UNIT-IV : INPUT/OUTPUT PORT EXPANSIONS AND FRONT PANEL I/O (9)

Synchronous serial port module - serial peripherals interface- output port expansion-input port expansion-LCD Display-motor control. Overview - Soft keys-state machines and key switches-Display of variable strings-Display of constant strings-Special features – configuration word-oscillator configuration – low power operation.

UNIT-V : PIC PROGRAMMING AND APPLICATIONS (9)

Programming Environment – Library functions – Closed loop control : Hysteresis & PI controller realization – DAQ board interface

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. John B.Peatman, “Design with PIC Microcontroller”, Pearson Education, Asia 2004.
2. MykePredko, “Programming and Customizing the PIC Microcontroller”, Tata McGraw Hill, Third Edition.1998

3. Rafiquzzaman M, " Microcontroller Theory and Applications with PIC18F", Wiley, 2011.
4. Rashid Mustafa, "Design development of PIC Microcontroller based embedded system", Lambert Academic Publishing, 2016.

COURSE OUTCOMES:

CO1: Demonstrate the principles, framework of microcontroller architectures and behaviors
CO2: Perform the Interfacing of microcontroller between digital system and I/O devices and Real time control
CO3: Outline the Display and I/O configurations
CO4: Design and develop single chip microcontroller based real time applications.

19PEPE08 DIGITAL SIGNAL PROCESSING AND CONTROL SEMESTER II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To emphasize intuitive understanding of the concepts of Digital Signal Processing and able to design theoretically the FIR and IIR Filters.
- To acquire knowledge on DSP processors and their applications in simple control systems.

UNIT-I : DISCRETE SIGNAL LINEAR SYSTEMS (9)

Discrete Linear systems – Time invariance –Causality, Stability, Difference Equations-Transfer functions of linear discrete systems – Impulse, step and frequency response – Linear and circular Convolution - Recursive and non-recursive filters – Digital filter realization – Direct, Canonic, Cascade, Parallel and ladder realizations.

UNIT-II : TRANSFORMATIONS IN DSP (9)

Review of Continuous Fourier series – Transform - Discrete Fourier Transform – Properties – IDFT- Introduction to Radix- 2 FFT – Properties – Decimation in time – Decimation in frequency – Computation of IDFT using DFT.

UNIT-III DIGITAL FILTERS (9)

Approximation of analog filters – Butterworth - Chebyshev – Properties of IIR filter – IIR filter design - Bilinear transformation and Impulse invariance method – Digital transformation – Characteristic of FIR filter - Frequency response of linear phase FIR filter Design of FIR filter – Fourier series method – Window function - Rectangular, Kaiser and Bartlett window methods.

UNIT-IV : dsPIC30f4011 (9)

dsPIC30F4011 – Architecture - MCU and DSP features - Hardware DMA - Interrupt Controller - Digital I/O, On-chip Flash, Data EE and RAM - Peripherals - Timers, Communication Modules Motor Control Peripherals - Capture/Compare/PWM, Analog-to-Digital Converters

UNIT-V : DSP CONTROLLER (9)

Introduction to DSP architecture - computational building blocks - Address generation unit, Program control and sequencing - Parallelism, Pipelining - Architecture of TMS320LF2407 - Addressing modes - I/O functionality, Interrupt. ADC, PWM, Event managers, Elementary Assembly Language Programming for control applications.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. John.G.Proakis, Dimitrias.G. and Manolakis. "DSP principles Algorithms and applications", Prentice Hall of India – Fourth Edition, 2001.
2. Emmanuel C.Ifeachor, University of Plymouth. Barrie.W.Jervis, Sheffield Hallam University,

"Digital Signal Processing. A Practical Approach", Pearson Education, II Edition, 2002.
3. SanjitK.Mitra, "Digital Signal Processing A computer Based approach" TataMcGrawHill, Fourth Edition, 2010.
4. FarzadNekoogar, Gene moriarty. "Digital Control Using Digital Signal Processing" P.H. International Inc. New Jersey.1999

COURSE OUTCOMES:

CO1: Classify the digital signals and systems and apply various transformation techniques to solve problems.
CO2: Develop the ability to realize simple filter for difference equation.
CO3: Design digital IIR and FIR filters for the given specifications.
CO4: Design and simulate digital filters with signal processing algorithm.
CO5: Examine the DSP controllers and understand its functioning for control applications.

19PEPE09 HIGH VOLTAGE DC TRANSMISSION SYSTEMS SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the HVDC transmission system and its control

UNIT-I DC POWER TRANSMISSION TECHNOLOGY (9)

Introduction - Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – MTDC systems – Types, Control and protection of MTDC systems - Planning for HVDC transmission – Modern HVDC – State of the art.

UNIT-II : ANALYSIS OF HVDC CONVERTERS (10)

Pulse number – Choice of converter configuration – Simplified analysis of Graetz circuits – Converter bridge characteristics – Characteristics of twelve - pulse converter – Detailed analysis of converter.

UNIT-III : HVDC SYSTEM CONTROL (8)

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 TYPICAL DISTURBANCES (9)

Introduction – Generation of harmonics – Design of AC filters – DC filters – Carrier frequency and RI noise - CIGRE benchmark model for HVDC control studies – Control system used - Results.

UNIT-V : SIMULATION OF HVDC SYSTEMS (9)

Introduction – System simulation: Philosophy and tools – HVDC system simulation – Modelling of HVDC systems for Digital Dynamic Simulation - Off-line and real time digital simulators.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Padiyar .K .R. , 'HVDC Power Transmission Systems ', New age international(P) Ltd, New Delhi, third edition,2015.
2. Edward Wilson Kimbark , 'Direct Current Transmission', Vol 1 , Wiley Interscience, Newyork, London, Sydney, 1971.
3. Vijay K. Sood, 'HVDC and FACTS Controllers – Applications of Static Converters in Power Systems', Kluwer Academic Publishers, 2006.
4. Rakosh Das Begamudre , 'Extra High Voltage AC Transmission Engineering' ,Wiley

Eastern Ltd, New Delhi, 2007.
5. Arrillaga .J, 'High Voltage Direct Current Transmission', Peter Pregrinus London, Second Edition, 1998.
6. Adamson .C and Hingorani N.G., 'High Voltage Direct Current Power Transmission", Garraway Ltd., London, 1967.

COURSE OUTCOMES:

CO1: Understand the concept and Identify the merits with necessity of HVDC transmission
CO2: Analyze and Design power converters for HVDC transmission system
CO3: Develop HVDC controllers in Real time power system environments
CO4: Explore Harmonics and Disturbances in HVDC environment
CO5: Model the HVDC system in simulation environment and study the performances

19PEPE10 FLEXIBLE AC TRANSMISSION SYSTEMS SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To elucidate the Power Quality Issues and Significance of Facts Devices in power system to improve the performance

UNIT-I INTRODUCTION (9)

FACTS- Basic concepts of static VAR compensator - Resonance damper, Thyristor controlled series capacitor –Static condenser-Phase angle regulator - other controllers.

UNIT-II : SERIES COMPENSATION SCHEMES (10)

Sub-Synchronous resonance-Torsional interaction, torsional torque - Compensation of conventional, ASC,NGH damping schemes - Modelling and control of thyristor controlled series compensators.

UNIT-III : UNIFIED POWER FLOW CONTROL (8)

Introduction - Implementation of power flow control using conventional thyristor - Unified Power Flow concept -Implementation of Unified Power Flow controller.

UNIT-IV : DESIGN OF FACTS CONTROLLERS (9)

Approximate multi model decomposition - Variable structure FACTS controllers for Power system transient Stability - Nonlinear variable -structure control - variable structure series capacitor control –Variable structure series resistor control -Modeling and methods of analysis of FACTS controllers.

UNIT-V : STATIC VAR COMPENSATION (9)

Basic concepts - Thysistor Controlled Reactor - Thyristor Switched Reactor - Thyristor Switched Capacitor -Saturated Reactor - Fixed Capacitor – applications

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Hingorani Narin G., Gyugyi Laszlo, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", Wiley-IEEE Press, 2001.
2. Narin G.Hingorani, "Flexible AC Transmission", IEE Spectrum, April 1993, pp 40-45.
3. Narin G.Hingorani,"High Power Electronics and Flexible AC Transmission Systems", IEEE High Power Engineering Review,1998.
4. Narin G.Hingorani,"Power Electronics in Electric Utilities:Role of Power Eletronics in future power systems",proc.of IEEE,Vol.76.no.4, April 1988.

5. Einar V.Larsen, Juan J.Sanchez-gasca and Joe H.chow, "Concepts for design of FACTS controller to damp power swings", IEEE Trans on Power System vol 10, no2, May 1995.

COURSE OUTCOMES:

CO1: Understand the concept of FACTS
CO2: Classify the FACTS devices and implementation in Real Power network
CO3: Design of FACTS controllers for real-time applications
CO4: Illustrate the concepts of Static VAR compensator
CO5: Use in Environment friendly applications in societal needs.

19PEPE11 POWER ELECTRONIC APPLICATIONS TO POWER SYSTEM **SEMESTER III**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize the students with the challenges for power electronics circuits when applied to real time power system projects

UNIT-I : POWER DEVICES AND CIRCUIT CONFIGURATION (9)

Comparison of various devices for converter circuits – Three phase Converters (line commutated and PWM) – Introduction to HVDC - Effect of source and load inductance – Harmonics in power system due to power converters - standards – Advanced converter topologies (Matrix and Multilevel)

UNIT-II : WIND AND SOLAR PV ENERGY CONVERSION SYSTEMS (9)

Basic components of wind energy conversion system- Generators –Types- Solar PV energy conversion system - DC and AC power conditioners for solar PV

UNIT-III : CONVERTER CONTROL (9)

Control characteristics of inverter and rectifier in HVDC–Over view of control techniques for grid connected converters-Control of active and reactive power.

UNIT-IV : POWER QUALITY AND FAULT ANALYSIS (9)

Impact of power electronics in power system-Harmonics- Flicker – Remedies-Fault behavior of wind and solar systems - International standards for grid integration of Renewable Energy Sources.

UNIT-V : MODELING AND POWER FLOW ANALYSIS (9)

Modeling-Converters – Filters-Load flow analysis-Power system with power converter based Renewable Energy-FACTS Controllers- Protection of power converters.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Rakesh Das Bagamudure, "Extra high voltage AC Transmission Engineering", New age International Ltd., Third Edition, 2007.
2. R.SastryVedam, S.Sarma, "Power Quality VAR compensation in Power systems", CRC Press,2009
3. Padiyar.K.R.,"HVDC Power Transmission System", Wiley Eastern Limited, New Delhi, 2011
4. Remus Teodorescu, Marco Liserre, Pedro Rodriguez "Grid Converters for Photovoltaic and Wind Power Systems"John Wiley and Sons Ltd.,2011
5. Mukund R Patel, "Wind and Solar power systems: design, analysis and operation", Second Edition, Taylor & Francis, 2006

COURSE OUTCOMES:

CO1: Identify the suitability of existing and new power electronic converter topologies for improving the performance of renewable energy system.

CO2: Analyze the power system with power electronics based controllers

CO3: Apply relevant power electronic circuits for wind and solar energy conversion systems.

19PEPE12 EVOLUTIONARY COMPUTATION SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts, recent techniques and applications in the field of evolutionary computation.

UNIT-I : INTRODUCTION (9)

Introduction to optimization – Concept of system and state – Performance measure – Constraints – Conditions for optimality – Linear and nonlinear optimization techniques – Stochastic optimization. Introduction to evolutionary computing – Comparison with traditional optimization techniques.

UNIT-II : GENETIC ALGORITHMS (GA) (9)

GA simulation – Schema processing – Data structures – reproduction – Crossover – Mutation – Fitness scaling – Constrained genetic algorithms- Penalty functions. Classification of GA - Simple GA – Compact GA – Orthogonal GA – Problems with GA – Genetic drift – Deception – Real-time and on-line issues – Algorithmic implementation of GA.

UNIT-III : GENETIC SEARCH TECHNIQUES (9)

Classes of search techniques – GA cycle – Distributed, parallel, structured GA, Dominance, Diploidy, Abeyance – Selection methods – Recombination – Discrete, real valued, binary valued – Single and multi- point crossover – Population models – Multi-objective optimization.

UNIT-IV : APPLICATIONS OF GA AND PSO (9)

GA in optimization of discrete and continuous systems – GA in pattern recognition – GA based machine learning – GA in signal processing – GA in computer communication. Particle Swarm Optimization (PSO) – Background, operation and basic flow of PSO – Applications of PSO - Comparison between PSO and GA.

UNIT-V : ANT COLONY OPTIMIZATION (9)

Ant colony optimization - Biological inspiration – Similarities and differences between real ants and artificial ants – Characteristics, algorithms and applications of ant colony optimization.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. KalamoyDeb,"Optimization for Engineering Design: algorithms and examples", Prentice Hall of India Ltd, 2004.
2. Pierre. D.A., "Optimization Theory with Applications", Courier Dover Publications, 1987
3. Rao S.S., "Optimization Theory and Applications", Halsted Press, II edition, 1984.
4. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", International Student Edition , Addison Wesley, 2007.
5. S.N.Sivanandam, S.N.Deepa, " Introduction of Genetic Algorithms" Springer, Newyork, 2010. IEEE Transactions on Evolutionary Computing

COURSE OUTCOMES:

CO1: Explore the traditional optimization and evolutionary computing techniques with comparison.

CO2: Identify the problem, issues and finding solution based on GA algorithms, PSO and ANT colony optimization techniques

CO3: Apply GA, PSO and ANT colony algorithms to solve real world problems.

CO4: Determine the appropriate parameter settings to make different evolutionary algorithms work well.

19PEPE13 INSULATION MATERIALS AND TESTING FOR INDUSTRIAL APPLICATIONS **SEMESTER III**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To be familiar with insulation materials, testing and measurement for industrial applications

UNIT-I : INSULATION MATERIALS AND MEASUREMENTS (9)

Dielectrics and insulators, resistance of insulation materials, tests and models. Electrical stress - Mechanical stress - Chemical Attack - Thermal stress - Environmental contamination - Predictive Maintenance - Benefit of new technology – Measurement of Insulation Resistance – Operation of insulation Resistance tester - The Guard Terminal - Evaluation and Interpretation of Results.

UNIT-II : INSULATION TESTS (9)

Diagnostic High Voltage Insulation Tests - Spot reading test - Time Vs. Resistance test - Polarization index test - Step voltage test - Ramp voltage test - Dielectric discharge test - Different Problems/different tests - Potential sources of error/ensuring Quality test – Results - Test leads - Making Measurements above 100 GΩ - Accuracy statements - Delivery of stated voltage - Interference Rejection - Rules on testing and comparing - CAT Rating - CAT Rating Guidelines – Importance of CAT rating - CAT Rating basic statistics.

UNIT-III : TESTING INSULATION RESISTANCE OF ROTATING MACHINERY (9)

Effects of temperature - Effects of Humidity - Ingress Protection - High Potential testing - Current (nA) Readings Vs. Resistance (MΩ) – Burn capability - Drying out electrical equipment - Test item discharge - Charging time for large equipment - Motor driven insulation testers - Test Lead Design - Significant safety enhancements - Things to consider for safe operation - Safety Warnings - Electrical insulation for rotating machines -Insulating liners, separators, sleeving and stator winding insulation.

UNIT-IV : EARTH RESISTIVITY AND MEASUREMENT (9)

Factors affecting Minimum Earth Resistance - Basic Definitions - Requirements for a Good Grounding System - National Electrical Code - Maximum Values - Nature of Earth Electrode - Principles Involved in Earth Resistance Testing - Basic Test Methods for Earth Resistance - Effects of Different Reference Probe Locations - Lazy Spikes - Supplementary Tests.

UNIT-V : ACCURATE MEASUREMENT OF EARTH RESISTANCE FOR LARGE (9)

Testing Challenges in Large Ground Systems – Addressing the Testing Challenges in Large Ground Systems – Nomograph Guide to Getting Acceptable Earth Resistance – Clamp-On Method – Attached Rod Techniques – Measurement of the Resistance of Large Earth Electrode Systems: Intersecting – Curves Method1 – Test as a Large Substation – General Comments – Slope Method – Four Potential Method – Star Delta Method – Determining Tough and Step Potential – Ground Testing Methods Chart.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. André O. Desjarlais and Robert R. Zarr"Insulation Materials: Testing and Applications", 4th Volume, ASTM International, Jan-2002.
2. Andrew R. Hileman,"Insulation Coordination for Power Systems", CRC Press, Jan 2002.
3. Joseph F. Kimpflen,"Insulation Materials, Testing, and Applications", ASTM International, Jan 1990.
4. George L Shew,"Earth Resistivity Measurement and its Application to Layer Problems", University of Southern California Press, 1936.

COURSE OUTCOMES:

CO1: Illustrate various measurements and tests of insulators in power system.
CO2: Comprehend the approaches of calculations of insulation specifications.
CO3: Practice the requirements of insulation as applied to large power system.

19PEPE14 POWER ELECTRONICS IN WIND AND SOLAR POWER CONVERSION SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To utilize the knowledge of power electronics to improve the performance of wind and solar energy conversion systems.

UNIT-I : ENERGY SOURCES AND GRID CODES (8)

Trends in energy consumption - World energy scenario – Energy sources and their availability - Conventional and renewable sources - Need to develop new energy technologies and Hybrid Systems – Grid requirements of solar PV and wind turbine (International standards) - Indian grid code for wind energy.

UNIT-II : SOLAR PHOTOVOLTAIC ENERGY CONVERSION (9)

Solar radiation and measurement - Solar atlas of India - Solar cells and their characteristics - Influence of insulation and temperature - PV arrays - Electrical storage with batteries – Maximum power point tracking techniques- Analysis of Photo Voltaic Systems.

UNIT-III : WIND ENERGY CONVERSION SYSTEM (9)

Basic Principle of wind Energy conversion - Wind survey in India - Power in the wind - Components of Wind Energy Conversion System - Classification of WECS - Performance of Induction Generators (SCIG and DFIG) and PMSGs for WECS - Maximum Power point tracking algorithms.

UNIT-IV : STAND ALONE SYSTEMS (9)

Self - Excited Induction Generator for isolated Power Generators - Theory of self - excitation - Capacitance requirements – Standalone solar PV system with energy storage - Hybrid system (Wind-Diesel-Solar) - Load sharing and sizing of system components.

UNIT-V : CONVERTERS FOR WIND AND SOLAR POWER SYSTEMS (10)

DC-DC Converters solar PV system - AC Power conditioners - Line commutated and PWM inverters - Synchronized operation with grid supply - Power converters for WECS - AC voltage controllers (soft starters), Machine side and grid side converter topologies - (two level and multilevel) - Harmonic filters (LC and LCL).

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Mukund R Patel, “Wind and Solar power systems: design, analysis and operation”, Second Edition, Taylor & Francis, 2006
2. Rai, G.D., "Non-conventional Energy Sources", Khanna Publications, New Delhi, V Edition,
3. Thomas Markvart and Luis Castaser, “Practical handbook of Photovoltaics”, Elsevier Publications, UK, 2003
4. Teodorescu.R, Liserre., and Rodriguez. P, “Grid converters for photovoltaic and wind power systems” JohnWiley and sons limited, 2011.

COURSE OUTCOMES:

CO1: Gain Knowledge of trends in renewable energy and standards for grid interconnection of resources.

CO2: Get exposure to the concept and science of energy conversion

CO3: Modify the existing technologies for efficient utilization in wind and solar energy conversion systems

CO4: Design of renewable energy based systems considering techno-economic factors

19PEPE15 DISTRIBUTED GENERATIONS AND MICROGRID SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the concept of distributed generations, grid integration and recent developments on Microgrid

UNIT-I : INTRODUCTION (9)

Conventional power generations – Energy crises – Non Conventional Energy resources : Review of Solar PV and Wind Energy Systems – Fuel cells – Micro turbines – Biomass – Tidal sources.

UNIT-II : DISTRIBUTED GENERATIONS (9)

Concept of distributed generations, topologies, selection of sources – Regulatory standards/Frame work – Standards for interconnecting Distributed resources to electric power systems: IEEE standard 1547 – DG installation classes – Security issues in DG implementations – Energy storage elements: Batteries, ultra- capacitors – Flywheels – Captive power plants.

UNIT-III : IMPACT OF GRID INTEGRATION (9)

Requirements for grid integration – Limits on operational parameters : voltage, frequency, THD - Response to grid abnormal operating systems – Islanding issues – Impact of grid integration with NCE sources on existing power system – Reliability, Stability and Power quality issues.

UNIT-IV : FUNDAMENTALS OF A MICROGRID (9)

Definition and Concept of micro grid – microgrid drivers and benefits – review of sources of microgrids – typical structure and configuration of a microgrid – AC and DC grids – Power electronic interfaces in DC and AC microgrids.

UNIT-V : CONTROL AND OPERATION OF MICROGRID (9)

Modes of operation and control of microgrid : grid connected and islanded mode – Active and reactive power control, protection issues – anti-islanding schemes: passive, active and communication based techniques – microgrid communication infrastructure – power quality issues in micro grid – regulatory standards – microgrid economics – introduction to smart grid.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Gevork B. Gharehpetian, "Distributed Generation Systems: Design, Operation and Grid Integration", Elsevier, 2017.
2. Fainan Hassan and Math H. J. Bollen, "Integration of Distributed Generation in the Power System", John Wiley and Sons. 2011.
3. Chetal Singh Solanki,"Solar Photovoltaics-Fundamentals, Technologies and applications", PH India, 2009.
4. Nikos Hatziargyriou, "Microgrid :Architecture and control", John Wiley, 2014.
5. Fereidoon P. Sioshansi, "Smart grid: Integrating renewable, Distributed and Efficient Energy", Elsevier, 2012.

COURSE OUTCOMES:

CO1: Able to illustrate the concept of distributed generations
CO2: Analyze the impact of grid integration
CO3: Recognize and design of Microgrid and its configuration
CO4: Explore the Economic aspects of Mircrogrid and Smart grid
CO5: Identify the implementation of distributed and microgrid based on the societal needs.

19PEPE16 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN **SEMESTER IV**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Outline the EMI/EMC problems and provide information for solutions to mitigate EMI through system level design as per prescribed standards.

UNIT-I : EMI ENVIRONMENT (9)

EMI/EMC concepts and definitions - Sources of EMI - conducted and radiated EMI - Practical Experiences and Constraints – An Overview of EMI and EMC – Analytical examples – Celestial Electromagnetic Noise – Lightning discharge – ESD - EMP.

UNIT-II : OPEN AREA TEST SITES, MEASURMENT OF RI AND CI (9)

Open area Test site and measurements – Measurement precautions, errors and site imperfections – Terrain roughness imperfections, normalized site attenuation – Antenna factor measurement – RI measurements – Anechoic chamber – TEM cell – Reverberating chamber – GTEM – Comparison. CI measurement - characterization of conduction currents and voltages – conducted EM noise on power supply lines – Conducted EMI from equipment, immunity, detectors and measurement.

UNIT-III : EMI MITIGATION (9)

Grounding – Shielding – Electrical Bonding – EMI Filters – characteristics – Power line filter design, installation and evaluation – EMI suppression cables - Connectors – gaskets – isolation transformers – opto isolators – transient and surge suppression devices – EMC accessories

UNIT-IV : SIGNAL INTEGRITY AND EMC STANDARDS (9)

SI problems – analysis – issues in design – modeling and simulation. Standards for EMI / EMC – BS, FCC, CISPR, IEC, EN – IEEE/ANSI standards - Military standards - MIL STD 461E/462 – VDE standards – EMI/EMC standards in Japan. Comparison.

UNIT-V : EMC DESIGN OF PCBs (9)

PCB Traces impedance - Routing, Control, Power Distribution Decoupling - Zoning, Motherboard Designs and Propagation Delay Performance Models.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Kodali V.P., "Engineering EMC Principles, Measurements and Technologies", IEEE Press, 2001.
2. Mark I Montrose., “EMC and the Printed Circuit Board Design, Theory and Layout Made Simple”, IEEE Press, 1999.
3. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley and Sons, NewYork, Second Edition, 1988.
4. Paul C.R., “Introduction to Electromagnetic Compatibility”, John Wiley and Sons Inc., Second Edition, 2006.
5. Kodali V.P., "Engineering EMC Principles, Measurements and Technologies", IEEE Press, 1996.
6. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, Third Edition, 1987.

COURSE OUTCOMES:

CO1: Review the basics of EMI/ EMC
CO2: Familiarize with EMI measurements Diagnose and solve basic electromagnetic compatibility problems.
CO3: Understand the EMI mitigation technologies and able to design filters
CO4: Gain knowledge on suppression cables, surge suppression devices and EMC accessories.
CO5: Possess knowledge on EMC standards
CO6: Design the Cable routing & connection and understand the Interconnection Techniques for EMI free system.

19PEPE17 COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES **SEMESTER IV**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To design and model the field oriented concepts of electrical machines using FEM and modern Engineering tools.

UNIT-I : DESIGN PROCEDURE (9)

Conventional design procedures – Limitations - Main dimensions and Field system of DC and AC machines - problems.

UNIT-II : MATHEMATICAL FORMULATIONS OF FIELD PROBLEMS (10)

Development of torque/force – Electromagnetic Field Equations – Magnetic Vector/ Scalar potential - Electrical Vector/ Scalar potential – Stored energy in field problems – Inductance – Laplace and Poisson’s equations – Maxwell equations – Problems.

UNIT-III : PHILOSOPHY OF FEM (9)

Differential / Integral equations – Numerical methods - Finite Difference method – Finite Element method – Moment method - Energy minimization – Variational method – 2D field problems – Discrimination – Shape functions – Stiffness matrix.

UNIT-IV : CAD PACKAGES (9)

Energy functional – Principle of energy conversion - Elements of a CAD System – Preprocessing – Modeling – Simple iterative methods - Newton Raphson and Gauss Seidal Methods - Meshing – Materials properties - Boundary Conditions – Solution techniques – Post processing and Optimization.

UNIT-V : APPLICATIONS (8)

Design of Solenoid Actuator – Switched reluctance motor - Induction motor - Stepper motor.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Mohan, Undeland and Robbins, 'Power Electronics; Converters, Applications and Design', John Wiley and Sons, 1989.
2. Erickson R W, 'Fundamentals of Power Electronics', Chapman and Hall, 1997.
3. Vithyathil J, 'Power Electronics: Principles and Applications', McGraw Hill, 1995
4. Grahame Holmes and Thomas A.Lipo, " Pulse Width Modulation for Power Converters: Principle and Practice", IEEE Press, John Wiley and Sons,2003.

COURSE OUTCOMES:

CO1: Understand the basic operations of various Power Converters Topology

CO2: Outline the fundamentals of PWM techniques and applying the real time systems

CO3: Explore the Steady-State, transient modelling and analysis of power converters with various PWM techniques.

CO4: Analysis and Design of Control Loops for PWM power converters

CO5: Use in Environment friendly applications like solid state drives and power quality in societal needs.

19PEPE18 MODERN POWER ELECTRONICS FOR TRACTION APPLICATIONS SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To annotate the theoretical concepts of dynamics of electric tractions using modern power electronics

UNIT-I : FUNDAMENTAL OF ELECTRIC DRIVES (9)

Basic concepts, Characteristics and operating modes of drive motors, Starting, braking and speed control of motors, Four quadrant drives, Nature and classification of load torque and associated controls used in Process industries, Selection of motors and rating.

UNIT-II : DC MOTOR DRIVES (9)

Starting, braking and speed control, Analysis of separately excited dc motor with continuous armature current and discontinuous armature current, Analysis of dc series motor drives, Comparative evaluation of phase angle control, Semi-converter operation of full converter, Single phase half controlled and fully controlled rectifier fed dc motors, Sequence control, Three phase half controlled and fully controlled rectifier fed dc motors, Dual converter with circulating and non-circulating current controlled drives, Closed loop control system of dc motor drives, Reversible drives, Analysis and performance characteristics of chopper fed dc motors, Motoring and braking operations, Multiphase chopper, Phase locked loop control of dc drive.

UNIT-III : INDUCTION MOTOR DRIVES (9)

Operation with unbalanced source voltages and unbalanced rotor impedances, Effect of time harmonics on the motor performance, Braking, Stator voltage control of induction motor, Variable voltage variable frequency (VVVF) operation, Voltage source inverter (VSI) fed induction motor drive, Static rotor resistance control, Slip power recovery systems, closed loop control of ac drives, Introduction to field oriented control of ac motors, Comparison of ac and dc drive, Their selection for particular application.

UNIT-IV : ELECTRIC TRACTION (9)

General features of electrical traction, Mechanics of train movement, Nature of traction load, Speed-time curves, Calculations of Traction drive rating and Energy consumption, Train resistance, Adhesive weight and Coefficient of Adhesion, Tractive effort for acceleration and propulsion,

Power and Energy output from driving axles, Methods of speed control and braking of motors for traction load, Electric drive systems for electric traction.

UNIT-V : TRACTION MOTORS AND CONTROL (9)

Desirable characteristics of Traction motors-Motors used for Traction purpose - Methods of starting and speed control of D.C Traction motors - Rheostatic Control - Energy saving with plain Rheostatic control - Series-parallel control - Energy saving with series parallel starting - Shunt Transititon – Bridge - Transition - Drum control - contactor type bridge Transition controller – Metadyne control - Multiple unit control - Regenerative braking.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. G.K. Dubey, "Fundamental of Electrical Drives", Narosa Publication, Reprint 2015
2. B.K. Bose, "Power Electronics & Variable Frequency drive", IEEE press,1997
3. K. Pillai, "First Course on Electrical Drives", New Age International 3rd edition 2017.
4. Vedam Subramanyam, "Electric Drives– concepts and applications", Tata McGraw Hill, 2011
5. C. Garg, "Utilization of Electrical Power and Electrical Traction", Khanna Publication. 1990

COURSE OUTCOMES:

CO1: Analyze the power converters for traction applications.
CO2: Analyze the performance of dc motor drives and induction motor drives for various operating conditions.
CO3: Estimate energy consumption rating of motor for traction application.
CO4: Understand about the various control methods for electrical traction.

19PEOE01 ENERGY AUDITING SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Comprehend energy management schemes and reform economic analysis and load management in electrical systems.

UNIT I : BASICS OF ENERGY MANAGEMENT (9)

Energy Scenario – Energy Sector Reforms – Impact on environment – Strategy for future and conservation – Basics of Energy and it forms (Thermal and Electrical). Energy Audit: Need – Types and Methodology - Audit Report – Energy Cost, Benchmarking and Energy performance – System Efficiency. Facility as an energy system – Methods for preparing process flow, Material and energy balance diagrams.

UNIT II : ACTION PLANNING AND MONITORING (9)

Energy Management System – Performance assessment – Goal setting by Manager – Action plan implementation – Financial Management: Investment - Financial analysis techniques, ROI, Risk and sensitivity analysis, role of Energy Service Companies. Project management: Steps in detail. – Energy monitoring and interpretance of variances for remedial actions. Environmental concerns: UNFCC – Kyoto protocol – COP – CDM – PCF – Sustainable development.

UNIT III : STUDY OF THERMAL UTILITIES (9)

Combustion of Oil, Coal and Gas – Performance Evaluation of Boilers – Boiler blow down – Boiler water treatment – Energy Conservation Opportunity – Cogeneration: Principal – Options -

Classification – Influencing Factors and technical parameters. Waste heat recovery: Classification – application – benefits - Different heat recovery devices.

UNIT IV : STUDY OF ELECTRICAL UTILITIES (9)

Electricity Billing – Electricity load management – Motor efficiency and tests – Energy efficient motors – Factors affecting motor efficiency and loss minimization – Motor load survey. Lighting System: Types and features – recommended luminance levels – Lighting system energy efficiency study – Energy Efficient Technologies: Maximum demand controllers – Intelligent PF controllers – Soft starters and VFDs – Variable torque load uses – Energy efficient transformers, Light controllers and Electronic ballasts.

UNIT V : ENERGY ASSESSMENT IN UTILITY SYSTEMS (9)

Performing Financial analysis: Fixed and variable costs – Payback period – methods – factors affecting analysis – Waste Minimization Techniques: Classification – Methodology. Performance assessment of HVAC Systems: Measurements, Procedure – Evaluation. Assessment of Pumps: Measurements, Procedure – Evaluation.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFRENCES:

1. Jeffrey Travis, Jim Kring, 'LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition), Prentice Hall, 2006.
2. Sanjeev Gupta, 'Virtual Instrumentation using LabVIEW' TMH, 2004
3. Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2001
4. Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003.
5. KevinJames, 'PC Interfacing and Data Acquisition:Techniques for Measurement, Instrumentation and Control', Newness, 2000

COURSE OUTCOMES:

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

CO1: Possess knowledge on energy management.
CO2: Analyze the feature of energy audit methodology and documentation of report.
CO3: Able to plan energy management action and develop the understanding of implementation.
CO4: Familiarize with thermal utilities and electrical utilities.
CO5: Perform assessment of different systems.

19PEOE02 ADVANCED ENERGY STORAGE TECHNOLOGY SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To explore the fundamentals, technologies and applications of energy storage.

UNIT I : ENERGY STORAGE: HISTORICAL PERSPECTIVE, INTRODUCTION AND CHANGES (9)

Storage Needs - Variations in Energy Demand - Variations in Energy Supply - Interruptions in Energy Supply - Transmission Congestion - Demand for Portable Energy - Demand and scale requirements - Environmental and sustainability issues.

UNIT II : TECHNICAL METHODS OF STORAGE (9)

Introduction: Energy and Energy Transformations, Potential energy (pumped hydro, compressed

air, springs) - Kinetic energy (mechanical flywheels) - Thermal energy without phase change passive (adobe) and active (water) -Thermal energy with phase change (ice, molten salts, steam) - Chemical energy (hydrogen, methane, gasoline, coal, oil) - Electrochemical energy (batteries, fuel cells) - Electrostatic energy (capacitors), Electromagnetic energy (superconducting magnets) - Different Types of Energy Storage Systems.

UNIT III : PERFORMANCE FACTORS OF ENERGY STORAGE SYSTEMS (9)

Energy capture rate and efficiency - Discharge rate and efficiency - Dispatch ability and load flowing characteristics, scale flexibility, durability – Cycle lifetime, mass and safety – Risks of fire, explosion, toxicity - Ease of materials, recycling and recovery - Environmental consideration and recycling, Merits and demerits of different types of Storage.

UNIT IV : APPLICATION CONSIDERATION (9)

Comparing Storage Technologies - Technology options - Performance factors and metrics - Efficiency of Energy Systems - Energy Recovery - Battery Storage System: Introduction with focus on Lead Acid and Lithium - Chemistry of Battery Operation, Power storage calculations, Reversible reactions, Charging patterns, Battery Management systems, System Performance, Areas of Application of Energy Storage: Waste heat recovery, Solar energy storage, Green house heating, Power plant applications, Drying and heating for process industries, energy storage in automotive applications in hybrid and electric vehicles.

UNIT V : HYDROGEN FUEL CELLS AND FLOW BATTERIES (9)

Hydrogen Economy and Generation Techniques, Storage of Hydrogen, Energy generation - Super capacitors: properties, power calculations – Operation and Design methods - Hybrid Energy Storage: Managing peak and Continuous power needs, options - Level 1: (Hybrid Power generation) Bacitor "Battery + Capacitor" Combinations: need, operation and Merits; Level 2: (Hybrid Power Generation) Bacitor + Fuel Cell or Flow Battery operation - Applications: Storage for Hybrid Electric Vehicles, Regenerative Power, capturing methods.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFRENCES:

1. Detlef Stolten,"Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications" Wiley, 2010.
2. Jiujun Zhang, Lei Zhang, Hansan Liu, Andy Sun, Ru-Shi Liu, "Electrochemical Technologies for Energy Storage and Conversion", John Wiley and Sons, 2012.
3. Francois Beguin and ElzbietaFrackowiak ,"Super capacitors", Wiley, 2013.
4. Doughty Liaw, Narayan and Srinivasan, "Batteries for Renewable Energy Storage", The Electrochemical Society, New Jersy,2010

COURSE OUTCOMES:

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

CO1: Recollect the historical perspective and technical methods of energy storage.
CO2: Learn the basics of different storage methods.
CO3: Determine the performance factors of energy storage systems.
CO4: Identify applications for renewable energy systems.
CO5: Understand the basics of Hydrogen cell and flow batteries.

19PEOE03 VIRTUAL INSTRUMENTATION SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To comprehend the Virtual instrument action programming concepts towards measurements

and control.

UNIT I : INTRODUCTION (9)

Introduction - advantages - Block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - Data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II : GRAPHICAL PROGRAMMING AND LabVIEW (9)

Concepts of graphical programming - LabVIEW software - Concept of VIs and sub VI – Display types - Digital - Analog - Chart and Graphs. Loops - structures - Arrays – Clusters - Local and global variables – String - Timers and dialog controls.

UNIT III : MANAGING FILES & DESIGN PATTERNS (9)

High-level and low-level file I/O functions available in LabVIEW – Implementing File I/O functions to read and write data to files – Binary Files – TDMS – sequential programming – State machine programming – Communication between parallel loops –Race conditions – Notifiers & Queues – Producer Consumer design patterns

UNIT IV : PC BASED DATA ACQUISITION (9)

Introduction to data acquisition on PC, Sampling fundamentals, ADCs, DACs, Calibration, Resolution, - analog inputs and outputs - Single-ended and differential inputs - Digital I/O, counters and timers, DMA, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT V : DATA ACQUISITION AND SIGNAL CONDITIONING (9)

Components of a DAQ system, Bus, Signal and accuracy consideration when choosing DAQ hardware – Measurement of analog signal with Finite and continuous buffered acquisition - analog output generation – Signal conditioning systems – Synchronizing measurements in single & multiple devices – Power quality analysis using Electrical Power Measurement tool kit.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFRENCES:

1. Murphy W.R. and G.Mckay Butter worth , “Energy Management”, Heinemann Publications.
2. John.C.Andreas, “Energy Efficient Electric Motors”, Marcel Dekker Inc Ltd – 2nd edition; 1995.
3. W.C.Turner, “Energy Management Handbook”, John Wiley and Sons, Fifth edition, 2009.
4. “Energy Management and Good Lighting Practice: fuel efficiency” – booklet 12 – EEO.
5. Paul o’ Callaghan, “Energy Management”,Mc-Graw Hill Book Company – 1st edition; 1998.
6. www.em-ea.org/gbook1.asp

COURSE OUTCOMES:

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

CO1: Gain Knowledge of graphical programming techniques using LabVIEW software.
CO2: Explore the basics of programming and interfacing using related hardware.
CO3: Outline the aspects and utilization of PC based data acquisition and Instrument interfaces.
CO4: Create programs and Select proper instrument interface for a specific application.

19PEOE04 DISTRIBUTION AUTOMATION SYSTEM SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study about the distributed automation and economic evaluation schemes of power network

UNIT I : INTRODUCTION (9)

Introduction to Distribution Automation (DA) - Control system interfaces - Control and data requirements - Centralized (vs) decentralized control - DA system - DA hardware - DAS software.

UNIT II : DISTRIBUTION AUTOMATION FUNCTIONS (9)

DA capabilities - Automation system computer facilities - Management processes - Information management - System reliability management - System efficiency management - Voltage management - Load management.

UNIT III : COMMUNICATION SYSTEMS (9)

Communication requirements – reliability - Cost effectiveness - Data requirements - Two way capability - Communication during outages and faults - Ease of operation and maintenance - Conforming to the architecture of flow. Distribution line carrier - Ripple control - Zero crossing technique - Telephone, cable TV, radio, AM broadcast, FM SCA,VHF radio, microwave satellite, fiber optics - Hybrid communication systems used in field tests.

UNIT IV : ECONOMIC EVALUATION METHODS (9)

Development and evaluation of alternate plans - select study area – Select study period - Project load growth - Develop alternatives - Calculate operating and maintenance costs - Evaluate alternatives.

UNIT V : ECONOMIC COMPARISON (9)

Economic comparison of alternate plans - Classification of expenses - capital expenditures - Comparison of revenue requirements of alternative plans - Book life and continuing plant analysis - Year by year revenue requirement analysis, Short term analysis - End of study adjustment - Break even analysis, sensitivity analysis - Computational aids.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFRENCES:

1. IEEE Tutorial course “Distribution Automation”,IEEE Working Group on Distribution Automation, IEEE Power Engineering Society. Power Engineering Education Committee, IEEE Power Engineering Society. Transmission and Distribution Committee, Institute of Electrical and Electronics Engineers, 1988
2. Taub, “Principles Of Communication Systems”, Tata McGraw-Hill Education, 07-Sep-2008
3. M.K. Khedkar, G.M. Dhole, “A Textbook of Electric Power Distribution Automation”, Laxmi Publications, Ltd., 2010.
4. Maurizio Di Paolo Emilio, “Data Acquisition Systems: From Fundamentals to Applied Design”, Springer Science & Business Media, 21-Mar-2013

COURSE OUTCOMES:

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

CO1: Analyse the requirements of distributed automation
CO2: Know the functions of distributed automation
CO3: Perform detailed analysis of communication systems for distributed automation.
CO4: Study the economic evaluation method
CO5: Understand the comparison of alternate plans

19PEOE05 POWER QUALITY ASSESSMENT AND MITIGATION **SEMESTER III**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To identify, analyze and create solutions for the power quality problems in power system networks.

UNIT I : INTRODUCTION (9)

Importance of power quality - Terms and definitions as per IEEE std.1159 for transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers - Symptoms of poor power quality - Definitions and terminology of grounding - Purpose of groundings - Good grounding practices - problems due to poor grounding.

UNIT II : FLICKERS AND TRANSIENT VOLTAGES (9)

RMS voltage variations in power system, complex power, voltage regulation and per unit system - Basic power flow and voltage drop - Devices for voltage regulation and impact of reactive power management - Causes and effects of voltage flicker - Short term and long term flickers - Methods to reduce flickers - Transient over voltages, impulsive transients, switching transients - Effect of surge impedance and line termination - control of transient voltages.

UNIT III : VOLTAGE INTERRUPTIONS (9)

Definitions - Voltage sags versus interruptions - Economic impact, Major causes and consequences - characteristics, assessment, Influence of fault location and fault level on voltage sag - Areas of vulnerability, Assessment of equipment sensitivity, Voltage sag limits for computer equipment - CBEMA, ITIC, SEMI F 42curves, Report of voltage sag analysis, Voltage sag indices, Mitigation measures for voltage sag- DSTATCOM, UPQC,UPS, DVR, SMEs, CVT, utility solutions and end user solutions.

UNIT IV : WAVEFORM DISTORTION (9)

Definition of harmonics, inter-harmonics, sub-harmonics - Causes and effects - Voltage versus current distortion, Fourier analysis, Harmonic indices, A.C. quantities under non-sinusoidal conditions, Triplet harmonics, characteristic and non characteristic harmonics - Series and Parallel resonances- Consequence - Principles for controlling and Reducing harmonic currents in loads, K-rated transformer - Computer tools for harmonic analysis - Locating sources of harmonics, Harmonic filtering - Passive and active filters - Modifying the system frequency response - IEEE Harmonic standard 519-1992.

UNIT V : ANALYSIS AND CONVENTIONAL MITIGATION METHODS (9)

Analysis of power outages, Analysis of unbalance condition: Symmetrical components in phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers - Analysis of distortion: On–line extraction of fundamental sequence components from measured samples – Harmonic indices – Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI) - Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFRENCES:

1. M. H. J. Bollen, “Understanding Power Quality Problems, Voltage Sag and Interruptions”, IEEE Press, series on Power Engineering, 2000.
2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and Wayne Beaty H., “Electrical Power System Quality”, Second Edition, McGraw Hill Publication Co., 2008.
3. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1994(2nd edition).
4. Enrique Acha, Manuel Madrigal, “Power System Harmonics: Computer Modeling and Analysis”, John Wiley and Sons, 2001.
5. Arrillaga J. and Watson N.“Power System Harmonics”2nd edition on; John Willey&sons, 2003
6. IEEE Std. 519-1992/ IEEE Std. 1159 IEEE recommended practices and requirements for

harmonics control in electrical power system.

COURSE OUTCOMES:

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

CO1: Acquire knowledge about the power quality issues and standards like IEEE,IEC on voltage, Frequency and harmonics.

CO2: Recognize the practical issues in the power system

CO3: Analyze the impact of power electronic devices and techniques in power system

CO4: Develop trouble shooting skills and innovative remedies for various power quality problems in power system

19CSOE06 HUMAN COMPUTER INTERACTION SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Describe the importance and need for effective user friendly Graphical User Interfaces(GUI).
- Choose suitable interactions devices/tools to meet application specific requirements.
- Design Graphical User Interfaces(GUI) using apt components and apply the design guidelines for user-friendly navigation and presentation.
- Asses graphical user interfaces for compliance against the screen design guidelines.

UNIT I : INTRODUCTION (9)

Importance of User Interface: Definition-Importance of good design-Benefits of good design-Human-centered development and Evaluation-Human Performance models-A Brief history of screen design.

UNIT II : THE GRAPHICAL USER INTERFACE & DESIGN PROCESS (9)

GUI: Popularity of graphics - The concept of direct manipulation - Graphical system - Characteristics - Web user – Interface Popularity - Characteristics and Principles of User Interface. Design process: Human Interaction with computers - Importance of Human Characteristics - Human Consideration – Human Interaction Speeds and Understanding Business Junctions.

UNIT III : SCREEN DESIGNING (9)

Design Goals - Screen Planning and Purpose - Organizing Screen Elements - Ordering of Screen Data and Content – Screen Navigation and Flow - Visually Pleasing Composition - Amount of Information - Focus and Emphasis - Presenting Information Simply and Meaningfully - Information retrieval on web - Statistical Analysis - Technological considerations in Interface Design.

UNIT IV : WINDOWS & COMPONENTS (9)

Windows: New Navigation Schemes - Selection of Window - Selection of Devices Based on Screen Based Controls. Components: Text and Messages - Icons and Increases - Multimedia - Colors - Uses -Problems - Choosing colors.

UNIT V : SOFTWARE TOOLS AND INTERACTION DEVICES (9)

Specification Methods - Interface Building Tools - Keyboard and Function Keys - Pointing Devices Speech Recognition.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFRENCES:

1. Wilbert O Galitz, "The Essential Guide to User Interface Design", Third Edition, Wiley India Pvt., Ltd., 2007.

2. Ben Shneidermann, "Designing the User Interface", Fifth edition, Pearson Education Asia, 2013. (Software Tools and Interaction Devices)
3. Alan Dix, Janet Finlay, G D Abowd and Russel Beale, "Human Computer Interaction", Pearson Education, Third Edition, 2004.

COURSE OUTCOMES:

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

CO1: Design effective dialog for HCI
CO2: Design effective HCI for individuals and persons with disabilities.
CO3: Assess the importance of user feedback.
CO4: Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites
CO5: Develop meaningful user interface.

19CSOE07 PATTERN RECOGNITION SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To get knowledge in pattern recognition in computer vision techniques
- To get knowledge in structural pattern methods
- To get knowledge on neural networks and fuzzy systems.

UNIT I : PATTERN CLASSIFIER (9)

Overview of pattern recognition - Discriminant functions - Supervised learning – Parametric estimation - Maximum likelihood estimation – Bayesian parameter estimation - Perceptron algorithm - LMSE algorithm – Problems with Bayes approach – Pattern classification by distance functions - Minimum distance pattern classifier

UNIT II : UNSUPERVISED CLASSIFICATION (9)

Clustering for unsupervised learning and classification - Clustering concept - C-means algorithm - Hierarchical clustering procedures - Graph theoretic approach to pattern clustering - Validity of clustering solutions.

UNIT III : STRUCTURAL PATTERN RECOGNITION (9)

Elements of formal grammars - String generation as pattern description - recognition of syntactic description – Parsing - Stochastic grammars and applications - Graph based structural representation.

UNIT IV : FEATURE EXTRACTION AND SELECTION (9)

Entropy minimization – Karhunen - Loeve transformation-feature selection through functions approximation- Binary feature selection.

UNIT V : NEURAL NETWORKS (9)

Neural network structures for Pattern Recognition –Neural network based Pattern associators-Unsupervised learning in neural Pattern Recognition-Self organizing networks-Fuzzy logic-Fuzzy classifiers-Pattern classification using Genetic Algorithms.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFRENCES:

1. R. O Duda, P.E Hart and Stork, “Pattern Classification”, Wiley, 2012.
2. Robert J. Sehalkoff, “Pattern Recognition: Statistical, Structural and Neural Approaches”, JohnWiley & Sons Inc., 2007.
3. Tou & Gonzales, “Pattern Recognition Principles”, Wesley Publication Company, 2000.

4. Morton Nadier and P. Eric Smith, “Pattern Recognition Engineering”, John Wiley & Sons, 2000.

COURSE OUTCOMES:

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

CO1: Apply parametric estimation and supervised learning techniques for pattern classification

CO2: Describe the structural pattern recognition methods

CO3: Apply neural networks, fuzzy systems and Genetic algorithms to pattern recognition and classification

19CSOE08 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING **SEMESTER III**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Artificial Intelligence and intelligent agents, history of Artificial Intelligence
- Building intelligent agents (search, games, constraint satisfaction problems)
- Machine Learning algorithms
- Applications of AI (Natural Language Processing, Robotics/Vision)
- Solving real AI problems through programming with Python, Tensor Flow and Keras library.

UNIT I : FOUNDATIONS OF AI (9)

Introduction - History of Artificial Intelligence - Intelligent Agents - Uninformed Search Strategies - Informed (Heuristic) Search Strategies - Adversarial Search - Constraint Satisfaction Problems.

UNIT II : SUPERVISED AND UNSUPERVISED LEARNING (9)

Maximum likelihood estimation - Regression - Linear, Multiple, Logistic - bias-variance, Bayes rule, maximum a posteriori inference - Classification techniques - k-NN, naïve Bayes - Decision Trees - Clustering - k-means, hierarchical, high-dimensional - Expectation Maximization.

UNIT III : ENSEMBLE TECHNIQUES AND REINFORCEMENT LEARNING (9)

Graphical Models - Directed and Undirected Models - Inference – Learning - maximum margin, support vector machines - Boosting and Bagging - Random Forests - PCA and variations - Markov models, hidden Markov models -Reinforcement Learning- introduction - Markov Decision Processes - Value-based methods - Q-learning - Policy-based methods

UNIT IV : DEEP LEARNING (9)

Neural Network Basics - Deep Neural Networks - Recurrent Neural Networks (RNN) - Deep Learning applied to Images using CNN - Tensor Flow for Neural Networks & Deep Learning

UNIT V : AI APPLICATIONS (9)

Applications in Computer Vision : Object Detection- Face Recognition - Action and Activity Recognition -Human Pose Estimation.

Natural Language Processing - Statistical NLP and text similarity - Syntax and Parsing techniques - Text Summarization Techniques - Semantics and Generation - Application in NLP - Text Classification -speech Recognition - Machine Translation - Document Summarization - Question Answering

Applications in Robotics: Imitation Learning - Self-Supervised Learning -Assistive and Medical Technologies - Multi-Agent Learning.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFRENCES:

1. Peter Norvig and Stuart J. Russell, “Artificial Intelligence: A Modern Approach”, Third edition
2. Tom Mitchell, “Machine Learning”, McGraw-Hill, 1997
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courvillem, "Deep Learning", MIT press, 2016.
4. Michael Nielson , “Neural Networks and Deep Learning”
5. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006
6. Richard Sutton and Andrew Barto, Reinforcement Learning: An introduction”, MIT Press,1998

COURSE OUTCOMES:

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

CO1: Develop expertise in popular AI & ML technologies and problem-solving methodologies.
CO2: Use fundamental machine learning techniques, such as regression, clustering, knearest neighbor methods, etc.
CO3: Distinguish between supervised and unsupervised machine learning methods.
CO4: Gain knowledge of the different modalities of Deep learning currently used.
CO5: Use popular AI & ML technologies like Python, Tensor flow and Keras to develop Applications

19CSOE09 COMPUTER NETWORK ENGINEERING SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- The hardware and software architecture of Computer Networks
- The concepts of internetworking
- Issues in resource allocation
- End-to-end protocols and data transmission
- Network management models

UNIT I : FOUNDATION (9)

Applications – Requirements – Network Architecture – Implementing Network software – Performance – Perspectives on connecting – Encoding – Framing – Error detection – Reliable transmission – Ethernet and Multiple Access Networks – Wireless.

UNIT II : INTERNETWORKING (9)

Switching and bridging – IP – Routing – Implementation and Performance – Advanced Internetworking – The Global Internet – Multicast – Multiprotocol and Label Switching – Routing among Mobile devices.

UNIT III : CONGESTION CONTROL AND RESOURCE ALLOCATION (9)

Issues in Resource allocation – Queuing disciplines – Congestion Control – Congestion avoidance mechanism – Quality of Service.

UNIT IV : END-TO-END PROTCOLS AND DATA (9)

Simple Demultiplexer – Reliable Byte Stream – Remote Procedure Call – RTP – Presentation formatting - Multimedia data.

UNIT V : NETWORK MANAGEMENT (9)

SNMP v1 and v2 Organization and information model - Communication model – Functional model - SNMP proxy server - Remote monitoring - RMON1 and RMON2.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFRENCES:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks a Systems approach", Fifth edition, Elsevier, 2011.
2. Priscilla Oppenheimer, "Top-down Network Design: A Systems Analysis Approach to Enterprise Network Design", 3rd Edition, Cisco Press, 2010.
3. James D. McCabe, Morgan Kaufmann, "Network Analysis, Architecture, and Design", Third Edition, Elsevier, 2007.
4. William Stallings, "SNMP, SNMPv2, SNMPv3, and RMON 1 and 2," Third Edition, Pearson Education, 2012
5. Mani Subramanian, "Network Management Principles and practice", Pearson Education, 2010.

COURSE OUTCOMES:

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

CO1: Explain the architecture and applications of Computer Networks and analyze the performance of MAC protocols.
CO2: Configure switches and Routers.
CO3: Design algorithms to ensure congestion control and QOS.
CO4: Appreciate the performance of End-to-End protocols and data transmission techniques.
CO5: Use SNMP and RMON.

19CSOE10 GREEN COMPUTING SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge to adopt green computing practices
- To minimize negative impacts on the environment
- To learn about energy saving practices
- To understand the impact of e-waste and carbon waste.

UNIT I : FUNDAMENTALS (9)

Green IT Fundamentals: Business, IT, and the Environment – Benefits of a Green Data Centre - Green Computing: Carbon Foot Print, Scoop on Power – Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

UNIT II : GREEN ASSETS AND MODELING (9)

Green Assets: Buildings, Data Centers, Networks, Devices, Computer and Earth Friendly peripherals, Greening Mobile devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models.

UNIT III : GRID FRAMEWORK (9)

Virtualizing of IT Systems – Role of Electric Utilities, Telecommuting, Teleconferencing and Teleporting – Materials Recycling – Best Ways for Green PC – Green Data Center – Green Grid Framework. Optimizing Computer Power Management, Seamless Sharing Across Systems. Collaborating and Cloud Computing, Virtual Presence.

UNIT IV : GREEN COMPLIANCE (9)

Socio-Cultural Aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, And Audits – Emergent Carbon Issues: Technologies and Future. Best Ways to Make Computer Greener.

UNIT V : GREEN INITIATIVES WITH IT and CASE STUDIES (9)

Green Initiative Drivers and Benefits with IT - Resources and Offerings to Assist Green Initiatives. Green Initiative Strategy with IT - Green Initiative Planning with IT - Green Initiative Implementation with IT - Green Initiative Assessment with IT. The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFRENCES:

1. Bhuvan Unhelkar, Green IT Strategies and Applications-Using Environmental Intelligence‖, CRC Press, June 2011
2. Carl Speshocky, Empowering Green Initiatives with IT, John Wiley and Sons, 2010.
3. Alin Gales, Michael Schaefer, Mike Ebbers, Green Data Center: Steps for the Journey‖, Shoff/IBM rebook, 2011.
4. John Lamb, The Greening of IT‖, Pearson Education, 2009.
5. Jason Harris, Green Computing and Green IT- Best Practices on Regulations and Industry‖, Lulu.com, 2008.
6. Woody Leonhard, Katherrine Murray, Green Home computing for dummies, August 2009.

COURSE OUTCOMES:

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

CO1: To explain the necessity of Green IT
CO2: To outline methodologies for creating Green Assets and their management
CO3: To appreciate the use of Grid in Green IT
CO4: To develop case studies related to Environmentally Responsible Business Strategies

19PEACZ1 - ENGLISH FOR RESEARCH PAPER WRITING
(Common to all Branches)

L	T	P	C
2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Writing quality research papers in English

UNIT I (6)

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II (6)

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism

UNIT III (6)

Sections of a Paper, Abstracts, Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV (6)

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT V (6)

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions, useful

phrases, how to ensure paper is as good as it could possibly be the first- time submission

CONTACT PERIODS:

Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 30 Periods

REFERENCE BOOKS:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

COURSE OUTCOMES:

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

CO1: Utilize writing skills to write best quality research paper and provide better readability.
CO2: Describe each section of a paper with clarity.
CO3: Review the papers efficiently.
CO4: Utilize the key skills to write title, abstract, introduction and literature review of the paper.
CO5: Write the methods, results, Discussion and Conclusion using the required skills and useful phrases.

19PEACZ2 - DISASTER MANAGEMENT
(Common to all Branches)

L	T	P	C
2	0	0	0

COURSE OBJECTIVES:

- Key concepts in disaster risk reduction.
- Types of disasters and hazards.
- Disaster prone areas in India.
- Strengths and weaknesses of disaster management approaches.
- Risk assessment methods.

UNIT I : INTRODUCTION (6)

Disaster: definition, factors and significance; difference between hazard and disaster; natural and manmade disasters: difference, nature, types and magnitude.

UNIT II : REPERCUSSIONS OF DISASTERS AND HAZARDS (6)

Economic damage, loss of human and animal life, destruction of ecosystem. Natural disasters: earthquakes, volcanisms, cyclones, tsunamis, floods, droughts and famines, landslides and avalanches, man-made disaster: nuclear reactor meltdown, industrial accidents, oil slicks and spills, outbreaks of disease and epidemics, war and conflicts.

UNIT III : DISASTER PRONE AREAS IN INDIA (6)

Study of seismic zones; areas prone to floods and droughts, landslides and avalanches; areas prone to cyclonic and coastal hazards with special reference to tsunami; post - disaster diseases and epidemics

UNIT IV : DISASTER PREPAREDNESS AND MANAGEMENT (6)

Preparedness: monitoring of phenomena triggering a disaster or hazard; evaluation of risk: application of remote sensing, data from meteorological and other agencies, media reports: governmental and community preparedness.

UNIT V : RISK ASSESSMENT **(6)**

Disaster risk: concept and elements, disaster risk reduction, global and national disaster risk situation. Techniques of risk assessment, global co- operation in risk assessment and warning, people's participation in risk assessment. Strategies for survival.

CONTACT PERIODS:

Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 30 Periods

REFERENCE BOOKS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company, 2007
2. Sahni, Pardeep Et.Al. (Eds.),"Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi, 2004
3. Goel S. L. , "Disaster Administration and Management Text and Case Studies" , Deep & Deep Publication Pvt. Ltd., New Delhi, 2007
4. Jagbir Singh, "Disaster Management: Future Challenges and Opportunities", I.K. International Publishing House Pvt. Ltd. , New Delhi, 2013.

COURSE OUTCOMES:

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

CO1: Differentiate hazard and disaster and types of disasters.

CO2: Identify the causes and types of manmade and natural disaster.

CO3: Describe the disaster prone areas in India.

CO4: To predict and, where possible, prevent disasters, mitigate their impact on vulnerable populations, and respond to and effectively cope with their consequences

CO5: Provide survival strategies based on risk assessment.

19PEACZ3 - VALUE EDUCATION
(Common to all Branches)

L	T	P	C
2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Value of education and self- development
- Requirements of good values in students
- Importance of character

UNIT I : ETHICS AND SELF-DEVELOPMENT **(6)**

Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements.

UNIT II : PERSONALITY AND BEHAVIOR DEVELOPMENT **(6)**

Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance.

UNIT III : VALUES IN HUMAN LIFE **(6)**

Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature , Discipline.

UNIT IV : VALUES IN SOCIETY **(6)**

True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits.

Association and Cooperation. Doing best for saving nature.

UNIT V : POSITIVE VALUES **(6)**

Character and Competence – Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

CONTACT PERIODS:

Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 30 Periods

REFERENCE BOOKS:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi, 1998
2. Dr. Yogesh Kumar Singh, "Value Education", A.P.H Publishing Corporation,New Delhi, 2010
3. R.P Shukla, "Value Education and Human Rights", Sarup and Sons, NewDelhi, 2004 https://nptel.ac.in/courses/109104068/36
4. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi, 1998

COURSE OUTCOMES:

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

CO1: Understand the values and work ethics
CO2: Enhance personality and behaviour development
CO3: Apply the values in human life.
CO4: Gain Knowledge of values in society.
CO5: Learn the importance of positive values in human life.

19PEACZ4 - CONSTITUTION OF INDIA
(Common to all Branches)

L	T	P	C
2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Indian constitution
- Constitutional rights & duties
- Organs of governance
- Local administration
- Roles and functions of Election commission

UNIT I : INDIAN CONSTITUTION **(6)**

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working) - Philosophy of the Indian Constitution: Preamble Salient Features

UNIT II : CONSTITUTIONAL RIGHTS & DUTIES **(6)**

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III : ORGANS OF GOVERNANCE **(6)**

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT IV : LOCAL ADMINISTRATION (6)

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT V : ELECTION COMMISSION (6)

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

CONTACT PERIODS:

Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 30 Periods

REFERENCE BOOKS:

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

COURSE OUTCOMES:

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

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3: Understand the various organs of Indian governance.

CO4: Familiarize with the various levels of local administration.

CO5: Gain knowledge on election commission of India.

19PEACZ5 - PEDAGOGY STUDIES
(Common to all Branches)

L	T	P	C
2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Understanding of various theories of learning, prevailing pedagogical practices and design of curriculum in engineering studies.
- Application of knowledge in modification of curriculum, its assessment and introduction of innovation in teaching methodology. Indian constitution

UNIT I : INTRODUCTION (6)

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

UNIT II : PEDAGOGICAL PRACTICES (6)

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies.

UNIT III : PEDAGOGICAL APPROACHES (6)

How can teacher education (curriculum and practicum) and the school curriculum and guidance

materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teacher's attitudes and beliefs and Pedagogic strategies.

UNIT IV : PROFESSIONAL DEVELOPMENT (6)

Professional development: alignment with classroom practices and follow-up support. Peer support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes.

UNIT V : CURRICULUM AND ASSESSMENT (6)

Research gaps and future directions Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.

CONTACT PERIODS:

Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 30 Periods

REFERENCE BOOKS:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

COURSE OUTCOMES:

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

CO1: Explain the concept of curriculum, formal and informal education systems and teacher education.

CO2: Explain the present pedagogical practices and the changes occurring in pedagogical approaches.

CO3: Understand the relation between teacher and community, support from various levels of teachers to students and limitation in resources and size of the class.

CO4: Perform research design in pedagogy and curriculum development.

19PEACZ6 - STRESS MANAGEMENT BY YOGA
(Common to all Branches)

L	T	P	C
2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Eight parts of yoga
- Techniques to achieve overall health of body and mind
- Breathing techniques and its effects

UNIT I (6)

Definitions of Eight parts of yog. (Ashtanga).

UNIT II (6)

Yam and Niyam - Do`s and Don't's in life.

UNIT III **(6)**

Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

UNIT IV **(6)**

Asan and Pranayam : Various yog poses and their benefits for mind & body.

UNIT V **(6)**

Regularization of breathing techniques and its effects-Types of pranayam.

CONTACT PERIODS:

Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 30 Periods

REFERENCE BOOKS:

1. "Yogic Asanas for Group Training-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata, 1998
3. Pandit Shambu Nath, "Speaking of Stress Management Through Yoga and Meditation", New Dawn Press,New Delhi, 2015
4. K.N Udupa, "Stress and its management by Yoga", Motilal Banarsidass Publ,New Delhi, 2007

COURSE OUTCOMES:

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

CO1: understand the basics of Yoga.
CO2: Identify Do's and Dont's in life.
CO3: Follow ethical and moral guidelines given by Yamas and Niyamas in life.
CO4: Develop healthy mind in a healthy body thus improving social health by Asan and Pranayam
CO5: Use breathing techniques to live a stress free life

19PEACZ7 - PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Common to all Branches)

L	T	P	C
2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Techniques to achieve the highest goal happily
- How to become a person with stable mind, pleasing personality and determination
- Awakening wisdom in students

UNIT I **(6)**

Neetisatakam - Holistic development of personality – Verses - 19,20,21,22 (wisdom) – Verses - 29,31,32 (pride & heroism) – Verses - 26,28,63,65 (virtue)

UNIT II **(6)**

Verses - 52,53,59 (dont's) -Verses - 71,73,75,78 (do's) - Approach to day to day work and duties - Shrimad Bhagwad Geeta - Chapter 2 -Verses 41, 47,48,

UNIT III **(6)**

Shrimad Bhagwad Geeta - Chapter 3 -Verses 13, 21, 27, 35, Chapter 6 -Verses 5,13,17, 23, 35,- Chapter 18 -Verses 45, 46, 48.

UNIT IV **(6)**

Statements of basic knowledge - Shrimad Bhagwad Geeta: - Chapter 2 - Verses 56, 62, 68 -

Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of Role model.

UNIT V **(6)**

Shrimad Bhagwad Geeta: Chapter 2 - Verses 17, Chapter 3-Verses 36,37,42, Chapter 4 -Verses 18, 38,39-Chapter 18 – Verses 37,38,63

CONTACT PERIODS:

Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 30 Periods

REFERENCE BOOKS:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata, 2012
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi, 2002
3. "Bhagavad Gita: The Song of God", Swami Mukundananda, Jagadguru Kripaluji Yog, USA, 2013
4. "Bhagavad-Gita As It Is", A.C. Bhaktivedanta Swami Prabhupada,, Bhaktivedanta

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the Holistic development

CO2: Understand the day to day to day work and duties

CO3: Understand mankind to peace and prosperity

CO4: Become versatile personality.

19PEACZ8 - SANSKRIT FOR TECHNICAL KNOWLEDGE
(Common to all Branches)

L	T	P	C
2	0	0	0

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Alphabets and tense of the language.
- Sentence formation
- The Technical information in Sanskrit Literature

UNIT I **(6)**

Alphabets in Sanskrit, Past/Present/Future Tense

UNIT II **(6)**

Simple Sentences - Order, Introduction of roots

UNIT III **(6)**

Technical information about Sanskrit Literature

UNIT IV **(6)**

Technical concepts of Engineering-Electrical, Mechanical

UNIT V **(6)**

Technical concepts of Engineering-Architecture, Mathematics

CONTACT PERIODS:

Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 30 Periods

REFERENCE BOOKS:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi, 2004
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication, 2012