P.S.R. ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Sevalpatti (P.O), Sivakasi – 626140.

M.E. Power Electronics and Drives

CURRICULUM
AND
SYLLABI

PG

Regulations 2019

Department of Electrical and Electronics Engineering

CANDIDATES ADMITTED DURING 2019-2020 AND ONWARDS

Institute Vision and Mission

Vision

- To contribute to the society through excellence in technical education with societal values and thus a valuable resource for industry and the humanity.

Mission

- To create an ambience for quality learning experience by providing sustained care and facilities.
- To offer higher level training encompassing both theory and practices with human and social values.
- To provide knowledge based services and professional skills to adapt tomorrow's technology and embedded global changes.

Department Vision and Mission

Vision

- To be a technical hub of creating Electrical and Electronics Engineers with superior quality, human values and ethical views

Mission

- To provide an excellent, innovative and comprehensive education in electrical and electronics engineering.
- To create a conducive learning environment and train the students in the latest technological development domain to enhance carrier opportunities
- To produce competent and disciplined engineers suitable for making a successful career in industry/research.

Programme Outcomes

PO1. Apply the knowledge of science and mathematics in designing, analyzing and using power converters for various industrial and domestic applications.
PO2. Design the modern electric machines, drives, power converters, and control circuits for specific application.
PO3. Use modern tools, professional software platforms, embedded systems for the diversified applications.
PO4. Explore ideas for inculcating research skills.
PO5. Solve the problems which need critical and independent thinking to show reflective learning.
PO6. Imagine the larger picture and correlate the domain knowledge with the global industrial problems.

Programme Specific Outcomes

PSO1. Professional knowledge in the field of power Electronics and drives and its applications in power sectors and core Industries.

PSO2. Enhance analytical skills to solve complex problems using soft controllers appropriate to its solutions that are technically sound, economically feasible and socially acceptable.

PSO3. Develop the student's ability to pursue research in emerging areas of Power Electronics and Drives.

PSO4. Exhibit professionalism, communication skills, ethical attitude, team work in their profession and adapt to current trends by engaging in lifelong learning.

P.S.R.ENGINEERING COLLEGE, SIVAKASI-626140
PG REGUALTIONS-2019
M.E. POWER ELECTRONICS AND DRIVES
CURRICULUM
[I – IV SEMESTERS - FULL TIME]

Total Credits: 68

SEMESTER – I

Sl	Code	Course Title	Category	L-T-P	C
1	192PE11	Applied Mathematics for Electrical Engineers	HS	3-0-0	3
2	192PE12	Modeling and Analysis of Electrical Machines	PC	3-0-0	3
3	192PE13	Analysis and Design of Power Converters	PC	3-0-0	3
4	192PE14	Analysis of Inverters	PC	3-0-0	3
5	192SE13	Research Methodology and IPR	MC	3-0-0	3
6	192PE17	Design and Simulation of Power Electronic Circuits Laboratory	PC	0-0-4	2
7	192ACXX	Audit Course- 1	MC	2-0-0	0
					No. of Credits:17

SEMESTER – II

Sl	Code	Course Title	Category	L-T-P	C
1	192PE21	Solid State DC Drives	PC	3-0-0	3
2	192PE22	Solid State AC Drives	PC	3-0-0	3
3	192PEXX	Elective - I	PC	3-0-0	3
4	192PEXX	Elective – II	PE	3-0-0	3
5	192PEXX	Elective – III	PE	3-0-0	3
6	192PE27	Power Electronics and Drives Laboratory	PE	0-0-4	2
7	192PE28	Mini Project and Technical Seminar	EEC	0-0-4	2
8	192ACXX	Audit Course– 2	MC	2-0-0	0
					No. of Credits: 19

SEMESTER – III

Sl	Code	Course Title	Category	L-T-P	C
1	192PEEXX	Elective - IV	PE	3-0-0	3
2	192OEXX	Open Elective	OE	3-0-0	3
3	192PE31	Project Work Phase- I	EEC	0-0-12	10
					No. of Credits: 16

SEMESTER – IV

Sl	Code	Course Title	Category	L-T-P	C
1	192PE41	Project Work Phase- II	EEC	0-0-24	16
					No. of Credits: 16

PC - Program Core, PE - Program Elective, OE – Open Elective, EEC – Employability Enhancement Course, MC – Mandatory Course, HS - Humanities and Science

PROGRAM ELECTIVES

Sl.	Code	Course Title	L-T-P	C
1.	192PEE01	Switched Mode and Resonant Converters	3-0-0	3
2.	192PEE02	Industrial Load Modeling and Control	3-0-0	3
3.	192PEE04	Flexible AC Transmission Systems	3-0-0	3
4.	192PEE05	Power Quality	3-0-0	3
5.	192PEE06	Special Electrical Machines	3-0-0	3
6.	192PEE07	Microcontroller and DSP Based System Design	3-0-0	3
7.	192PEE09	Pulse Width Modulation for Power Converters	3-0-0	3
8.	192PEE10	Power Electronics in Power Systems	3-0-0	3
9.	192PEE11	Soft Computing Techniques	3-0-0	3
10.	192PEE12	Fundamentals of Nature Inspired Algorithms	3-0-0	3
11.	192PEE13	High Voltage Direct Current Transmission	3-0-0	3
12.	192PEE14	Smart Grid	3-0-0	3
13.	192PEE15	Power Electronics for Renewable Energy Systems	3-0-0	3
14.	192PEE17	Wind Energy Conversion Systems	3-0-0	3
15.	192PEE19	Digital Controllers for Power Electronics and Drives Applications	3-0-0	3
16.	192PEE20	Distributed Generation and Micro-Grids	3-0-0	3
17.	192PEE22	Electric and Hybrid Vehicles	3-0-0	3
18.	192PEE23	Advanced Power Electronics	3-0-0	3
19.	192PEE24	Energy Storage Systems	3-0-0	3
20.	192PEE26	Condition Monitoring of High Voltage Power Apparatus	3-0-0	3
21.	192PEE27	Fundamentals of Nano Technology	3-0-0	3

OPEN ELEVTIVE					
S. No.	**Code**	**Course Title**	**Category**	**L-T-P**	**C**
1	192OE01	Business Analytics	OE	3-0-0	3
2	192OE02	Industrial Safety	OE	3-0-0	3
3	192OE03	Operations Research	OE	3-0-0	3
4	192OE04	Design of Experiments	OE	3-0-0	3
5	192OE05	Composite Materials	OE	3-0-0	3
6	192OE06	Cost Management of Engineering Projects	OE	3-0-0	3
7	192OE07	Waste to Energy	OE	3-0-0	3
8	192OE08	Nanomaterials and Nanotechnology	OE	3-0-0	3

AUDIT COURSES					
S. No.	**Code**	**Course Title**	**Category**	**L-T-P**	**C**
1	192AC01	Constitution of India	MC	2-0-0	0
2	192AC02	Disaster Management	MC	2-0-0	0
3	192AC03	English For Research Paper Writing	MC	2-0-0	0
4	192AC04	Sanskrit for Technical Knowledge	MC	2-0-0	0
5	192AC05	Value Education	MC	2-0-0	0
6	192AC06	Pedagogy Studies	MC	2-0-0	0
7	192AC07	Stress Management by Yoga	MC	2-0-0	0
8	192AC08	Personality Development through Life Enlightenment Skills	MC	2-0-0	0

SEMESTER I

192PE11	**APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS**	**L-T-P**	**C**
		3-0-0	**3**

Programme: M.E. Power Electronics and Drives **Sem: I Category: HS**

Aim: To develop the mathematical skill in the area of Applications in Electricals.

Course Outcome:

The students can able to,

CO1. Develop the ability the concept of matrix theory
CO2. Apply the concept of calculus variations to first and higher order derivatives
CO3. Perform variation for independent variables
CO4. Analyze the random variables and apply to the electrical engineering problems
CO5. Formulate and find optimal solution in the real life optimizing
CO6. Solve problems using fourier transforms associated with electrical engineering problems

MATRIX THEORY **9**

The Cholesky decomposition - Generalized Eigen vectors, Canonical basis - QR factorization - Least squares method - Singular value decomposition.

CALCULUS OF VARIATIONS **9**

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – problems with constraints - Direct methods: Ritz and Kantorovich methods.

ONE DIMENSIONAL RANDOM VARIABLES **9**

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

LINEAR PROGRAMMING **9**

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models.

FOURIER SERIES **9**

Fourier Trigonometric series: Periodic function as power signals – Convergence of series –Even and odd function: cosine and sine series – Non-periodic function: Extension to otherintervals - Power signals: Exponential Fourier series – Parseval's theorem and power spectrum– Eigen value problems and orthogonal functions – Regular Sturm-Liouville systems –Generalized Fourier series.

Total Periods 45

REFERENCE BOOKS:

1. Richard Bronson, "Matrix Operation", Schaum's outline series, 2nd Edition, McGraw Hill, 2011.
2. Gupta, A.S., Calculus of Variations with Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
3. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes, Academic Press, (An imprint of Elsevier), 2010.
4. Taha, H.A., "Operations Research, An introduction"**,** 10th edition, Pearson education, New Delhi, 2010.
5. Andrews L.C. and Phillips R.L., Mathematical Techniques for Engineers and Scientists, Prentice

Hall of India Pvt..Ltd., New Delhi, 2005.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2			1	3	2	1	
CO2	3	2	1			1	3	1	1	
CO3	3	2	1	1	2		1	1	1	1
CO4	3	1	1		2		3	3	2	1
CO5	3		2	1	1		2	2	1	1
CO6	3	2		1	1		3	2	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PE12 MODELING AND ANALYSIS OF ELECTRICAL MACHINES **L-T-P C**

3-0-0 3

Programme: M.E Power Electronics and Drives **Sem: I Category: PC**

AIM: To provide a framework of techniques for analysis and simulation of performance of electrical machines**.**

Course Outcomes:

The Students will be able to

CO1. Analysis and modeling of force/torque equation of single and multi-excited electromagnetic systems.
CO2. Design any other Static and rotating reference frames
CO3. Clarify steady state and dynamic characteristics of DC motors
CO4. Explain steady state and dynamic characteristics of induction motors
CO5. Explain steady state and dynamic characteristics of synchronous machines
CO6. Analyze the computer simulation in arbitrary reference frame

PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION 9

General expression of stored magnetic energy, co-energy and force/ torque – example using single and doubly excited system –Calculation of air gap mmf and per phase machine inductance using physical machine data.

REFERENCE FRAME THEORY 9

Static and rotating reference frames – transformation of variables – reference frames – transformation between reference frames – transformation of a balanced set –balanced steady state phasor and voltage equations – variables observed from several frames of reference.

DC MACHINES 9

Voltage and torque equations – dynamic characteristics of permanent magnet and shunt DC motors – state equations - solution of dynamic characteristic by Laplace transformation.

INDUCTION MACHINES 9

Voltage and torque equations – transformation for rotor circuits – voltage and toque 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.

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.

Total Periods 45

References

1. Paul C.Krause, Oleg Wasyzczuk, Scott S, Sudhoff, “Analysis of Electric Machinery and Drive Systems”, IEEE Press, 2nd Edition.
2. R.Krishnan, “Electric Motor Drives, Modeling, Analysis and Control”, Prentice Hall of India, 2002.
3. R.Krishnan, “Electric Motor Drives, Modeling, Analysis and Control”, Prentice Hall of India, 2002.
4. Samuel Seely, “Electromechanical Energy Conversion”, Tata McGraw Hill Publishing

Company.2000.
5. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, "Electric Machinery", Tata McGraw Hill, 6th Edition, 2002.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3		2		1		3	2	2	1
CO2	2	3	1	1		1	2	1	1	1
CO3		3	1		2		3	2	1	1
CO4		3	1		2		3	2	1	1
CO5		3	1		2		3	2	1	1
CO6		2	3	1			1	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PE13	ANALYSIS AND DESIGN OF POWER CONVERTERS	L-T-P	C
		3-0-0	3

Programme: M.E-Power Electronics and Drives **Sem: 1** **Category: PC**

AIM: To provide the electrical circuit concepts behind the different working modes of power converters so as to enable deep understanding of their operation.

Course Outcomes:

The Students will be able to

CO1. Construct the Principles of various Electromagnetic Energy Conversion.
CO2. Analyze the steady state continuous and discontinuous modes and basic converter topologies.
CO3. Analyze the 3 Φ ac-to-dc converter.
CO4. Design choppers and analyze about the various topologies in converter.
CO5. Design AC voltage controller and cyclo-converter.
CO6. Illustrate the principles and operation of 1 Φ and 3 Φ Dual converters.

SINGLE PHASE AC-DC CONVERTER **9**

Static Characteristics of power diode, SCR and GTO, half controlled and fully controlled converters with R-L, R-L-E loads and freewheeling diodes – continuous and discontinuous modes of operation - inverter operation –Sequence control of converters – performance parameters: harmonics, ripple, distortion, power factor – effect of source impedance and overlap-reactive power and power balance in converter circuits.

THREE PHASE AC-DC CONVERTER **9**

Semi and fully controlled converter with R, R-L, R-L-E - loads and freewheeling diodes – inverter operation and its limit – performance parameters – effect of source impedance and overlap – 12 pulse converter.

DC-DC CONVERTERS **9**

Principles of step-down and step-up converters – Analysis of buck, boost, buck-boost and Cuk converters – time ratio and current limit control – Full bridge converter – Resonant and quasi – resonant converters.

AC VOLTAGE CONTROLLERS **9**

Static Characteristics of TRIAC- Principle of phase control: single phase and three phase controllers – various configurations – analysis with R and R-L loads.

CYCLOCONVERTERS **9**

Principle of operation – Single phase and Three-phase Dual converters - Single phase and three phase cyclo-converters – power factor Control – Introduction to matrix converters

Total Periods 45

References

1. Ned Mohan, T.M Undeland and W.P Robbin, “Power Electronics: converters, Application and design” John Wiley and sons. Wiley India edition, 2006.
2. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Prentice Hall of India, New Delhi, 2004.
3. Cyril W.Lander, “Power Electronics”, Third Edition McGraw hill-1993
4. P.C Sen.," Modern Power Electronics ", Wheeler publishing Co, First Edition, New Delhi-1998.
5. P.S. Bimbra, “Power Electronics”, Khanna Publishers, Eleventh Edition, 2003.

6. Vedam Subramanyam, “Power Electronics”, New Age International publishers, New Delhi Second Edition, 2006

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	1	3		1		2	1	1	1
CO2	1	3	1		2		3	2	1	1
CO3	1	3	1		2		1	1	1	1
CO4	2	3		1		1	3	2	1	1
CO5	2	3			1		1	2	1	1
CO6	2	3			1		2	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PE14	ANALYSIS OF INVERTERS	L-T-P	C
		3-0-0	3

Programme: M.E.-Power Electronics and Drives **Sem: 1** **Category: PC**

AIM: To analyze the structure and functioning of inverter circuits.

Course Outcomes:

The students can able to,

CO1. Construct the principle and operation of single phase inverters.
CO2. Analysis the various harmonic elimination techniques and commutated methods.
CO3. Evaluate the conduction mode of inverters.
CO4. Knowledge about modulation techniques in inverters.
CO5. Represent the current and voltage source inverters.
CO6. Construct the various multilevel inverters.
CO7. Illustrate the various types of resonant inverters.

SINGLE PHASE INVERTERS **9**

Introduction to self commutated switches : MOSFET and IGBT - Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – Various harmonic elimination techniques – Forced Commutated Thyristor Inverters.

THREE PHASE VOLTAGE SOURCE INVERTERS **9**

180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques.

CURRENT SOURCE INVERTERS **9**

Operation of six-step thyristor inverter – inverter operation modes – load – commutated inverters – Auto sequential current source inverter (ASCI) – current pulsations – comparison of current source inverter and voltage source inverters.

MULTILEVEL INVERTERS **9**

Multilevel concept – diode clamped – flying capacitor – cascade type multilevel inverters - Comparison of multilevel inverters - application of multilevel inverters.

RESONANT INVERTERS **9**

Series and parallel resonant inverters - voltage control of resonant inverters – Class E resonant inverter – resonant DC – link inverters.

Total Periods 45

References

1. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Prentice Hall India,3rd Edition, New Delhi, 2004.
2. Jai P.Agrawal, “Power Electronics Systems”, Pearson Education, 2nd Edition, 2002.
3. BimalK.Bose “Modern Power Electronics and AC Drives”, Pearson Education, 2nd Edition, 2003.
4. Ned Mohan, Undeland and Robbin, “Power Electronics: converters, Application and design” John Wiley and sons.Inc, Newyork, 1995.
5. Philip T. Krein, “Elements of Power Electronics” Oxford University Press -1998.
6. P.C. Sen, “Modern Power Electronics”, Wheeler Publishing Co, 1st Edition, New Delhi, 1998.
7. P.S.Bimbra, “Power Electronics”, Khanna Publishers, 11th Edition, 2003.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	3		1		1	3	3	2	1
CO2	2	3	1	1			3	3	3	1
CO3	3	2			1		3	3	2	1
CO4	2		3		1		3	3	3	1
CO5	1	3	2			1	3	3	1	1
CO6	2	3		1		1	3	3	3	1
CO7	3	2			1		3	3	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SE13 RESEARCH METHODOLOGY AND IPR L-T-P C

3-0-0 3

Programme: M.E Power Electronics and Drives **Sem: I Category: MC**

AIM: The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property. It will create consciousness for Intellectual Property Rights and its constituents. Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.

Course Outcomes:

The Students will be able to

CO1. Discuss research methodology basics
CO2. Formulate the research problems based on the literature review.
CO3. Interpret the test data.
CO4. Analyze the test data using analysis techniques.
CO5. Develop the art of writing research reports
CO6. Summarize about intellectual property and research ethics.

BASICS IN RESEARCH 9

Meaning of Research, Types of Research, Research Process, Problem definition, Objectives of Research, Research Questions, Research design, Approaches to Research, Quantitative vs. Qualitative Approach, Understanding Theory, Building and Validating Theoretical Models, Exploratory vs. Confirmatory Research, Experimental vs Theoretical Research, Importance of reasoning in research.

LITERATURE REVIEW AND PROBLEM FORMULATION 9

Problem Formulation, Understanding Modeling & Simulation, Conducting Literature Review, Referencing, Information Sources, Information Retrieval, Role of libraries in Information Retrieval, Tools for identifying literatures, Indexing and abstracting services, Citation indexes

TESTING, INTERPRETATION AND DATA COLLECTION 9

Experimental Research: Cause effect relationship, Development of Hypothesis, Measurement Systems Analysis, Error Propagation, Validity of experiments, Statistical Design of Experiments, Field Experiments, Data/Variable Types & Classification, Data collection, Numerical and Graphical Data Analysis: Sampling, Observation, Surveys, Inferential Statistics, and Interpretation of Results

REPORT WRITING 9

Preparation of Dissertation and Research Papers, Tables and illustrations, Guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript. References, Citation and listing system of documents

INTELLECTUAL PROPERTY RIGHTS 9

Scope of Patent Rights- Licensing and transfer of technology- Intellectual property rights (IPR) - patents-copyrights-Trademarks-Industrial design geographical indication. Ethics of Research-Scientific Misconduct- Forms of Scientific Misconduct. Plagiarism, Unscientific practices in thesis work, Ethics in science

Total Periods 45

Text Books

1. Bordens, K. S. and Abbott, B. B., "Research Design and Methods – A Process Approach", 8th Edition, McGraw-Hill, 2011
2. C. R. Kothari, "Research Methodology – Methods and Techniques", 2nd Edition, New Age International Publishers
3. Davis, M., Davis K., and Dunagan M., "Scientific Papers and Presentations", 3rd Edition, Elsevier Inc.
4. Michael P. Marder," Research Methods for Science", Cambridge University Press, 2011
5. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age". Aspen Law & Business; 6 edition July 2012

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1			1	3		2	3		2	2
CO2			1	3	2		2	2	2	
CO3				3	2	1			3	
CO4	3		2	1			3	1	2	1
CO5				3	2			2	3	2
CO6				3	2	1	1		1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PE17 DESIGN AND SIMULATION OF POWER ELECTRONIC CIRCUITS LABORATORY **L-T-P C**

0-0-4 2

Programme: M.E Power Electronics and Drives **Sem: I Category: PC**

AIM: To analyze, design and simulate different power converters studied in the core courses on power converters

Course Outcomes:

The Students will be able to

CO1. Acquire and apply knowledge of mathematics and converter in Electronics engineering.
CO2. Model and analyze power electronic systems and equipment using computational software and to understand their various operating modes.
CO3. Formulate, design, simulate single phase and three phase Converters.
CO4. Formulate, design, simulate single phase and three phase Inverters.
CO5. Formulate, design, simulates DC-DC Converters and Cyclo Converters.
CO6. Formulate, design, simulates SMPS.

LIST OF EXPERIMENTS

1. Simulate and experimental verification of Single phase Semi converter
2. Simulate and experimental verification of Single phase Fully controlled converter
3. Simulation of Single phase PWM inverter
4. Simulate and experimental verification of Three phase bridge inverter.
5. Simulate and experimental verification of Three phase semi converter
6. Simulation of Three phase fully controlled converter
7. Simulation of D.C-D.C Converters
8. Simulation of single phase AC Voltage Controller and Cyclo converter.
9. Simulation of Basic Multilevel Inverter.
10. Design and Simulation of SMPS

Total Periods 45

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1				3	3		
CO2	3	1	2	1			3	3	3	1
CO3	2	3	1				3	3	2	1
CO4	2	3	1				3	3	2	1
CO5	2	3	1				3	3	2	1
CO6	2	3	1				3	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SEMESTER –II

192PE21	**SOLID STATE DC DRIVES**	**L-T-P**	**C**
		3-0-0	**3**

Programme: M.E-Power Electronic and Drives **Sem: II Category: PC**

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

Course Outcome:

The students can able to,

CO1. Understand the different types of drive characteristics.
CO2. Design and Analyze the converter fed DC Drive.
CO3. Analyze the chopper fed DC Drive.
CO4. Design and analyze the different type of controllers for Drive.
CO5. UnderstandtheoperationPhase Locked Loop control of DCmotordrives.
CO6. Understand the operation Microcomputer control of DC motor drives.

DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS 9

DC motor- Types, induced emf, speed-torque relations – Constant torque and constant horse power operation - Introduction to high speed drives and modern drives. Characteristics of mechanical system – dynamic equations, components of torque, types of load; Requirements of drives characteristics – multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating-applications of drive system.

CONVERTER CONTROL 9

Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters – waveforms, performance parameters, performance characteristics. Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with freewheeling diode; Drive employing dual converter.

CHOPPER CONTROL 9

Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control - Chopper based implementation of braking schemes; Multi-phase chopper; Related problems.

CLOSED LOOP CONTROL 9

Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements - Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Simulation of converter and chopper fed d.c drive.

DIGITAL CONTROL OF DC DRIVE 9

Phase Locked Loop and micro-computer control of DC drives – Program flow chart for constant horse power and load disturbed operations; Speed detection and gate firing.

Total Periods 45

Text Books

1. Gopal K Dubey, “Power Semiconductor controlled Drives”, Prentice Hall Inc., New Jersy, 1989.
2. P.C Sen “Principles of Electrical Machines and Power Electronics” 2nd Edition, John Wiley and sons., New York, 1997.

References

1. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
2. GobalK.Dubey, "Fundamentals of Electrical Drives", Narosal Publishing House, New Delhi, 2001.
3. BimalK.Bose "Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003.
4. VedamSubramanyam, "Electric Drives – Concepts and Applications", Tata McGraw-Hill publishing company Ltd., New Delhi, 2nd Edition, 2010.
5. S.K. Pillai "Fundamental Of Electrical Drives "New Age publications., New Delhi, 2nd Edition, Reprint 2004.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3		1	1			3		2	
CO2	2	3		1			3	3	3	1
CO3	2	3	1				3	3	3	1
CO4	2	3	1	1			3	3	3	1
CO5	2	3			1	1	3		3	1
CO6	2	3			1	1	3		3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PE22 SOLID STATE AC DRIVES L-T-P C
3-0-0 3

Programme: M.E-Power Electronic and Drives **Sem: II Category: PC**

AIM: To study and understand the operation of both conventional speed control and power electronic control of AC motors.

Course Outcome:

CO1: Explain the various operating regions of the induction motor drives.
CO2: Analyze the operation of VSI & CSI fed induction motor control.
CO3: Explicit the speed control of induction motor drive from the rotor side.
CO4: Illustrate the field oriented control of induction machine.
CO5: Compute torque expression and to analyze DTC control strategy.
CO6: Interpret the performance of synchronous motor drives.

INTRODUCTION TO INDUCTION MOTORS 9

Steady state performance equations– Rotating magnetic field–torque production, Equivalent circuit– Variable voltage, constant frequency operation–Variable frequency operation, constant Volt/Hz operation. Drive operating regions, variable stator current operation, different braking methods.

VSI AND CSI FED INDUCTION MOTOR CONTROL 9

AC voltage controller circuit–six step inverter voltage control-closed loop variable frequency PWM inverter with dynamic braking-CSI fed IM variable frequency drives comparison

ROTORCONTROLLEDINDUCTIONMOTORDRIVES 9

Static rotor resistance control- injection of voltage in the rotor circuit–static scherbius drives- power factor considerations– modified Kramer drives

FIELD ORIENTEDCONTROL 9

Field oriented control of induction machines –Theory –DC drive analogy–Direct and Indirect methods– Flux vector estimation - Direct torque control of Induction Machines– Torque expression with stator and rotor fluxes, DTC control strategy.

SYNCHRONOUS MOTOR DRIVES 9

Wound field cylindrical rotor motor–Equivalent circuits–performance equations of operation from a voltage source –Power factor control and V curves–starting and braking, self control– Load commutated Synchronous motor drives-Brush and Brush less excitation.

Total Periods 45

References

1. Bimal K. Bose,"ModernPowerElectronicsandACDrives",PearsonEducationAsia2002.
2. VedamSubramanyam, "Electric Drives– Concepts and Applications", Tata McGraw Hill,1994.
3. Gopal K.Dubey,"Power Semi-conductor controlled Drives", Prentice Hall Inc.,NewYersy1989.
4. R.Krishnan, "Electric Motor Drives–Modeling, Analysis andControl",Prentice-HallofIndiaPvt.Ltd.,NewDelhi,2003.
5. W.Leonhard, "Control of Electrical Drives", Narosa Publishing House, 1992.
6. MurphyJ.M.DandTurnbull,"ThyristorControlofACMotors",PergamonPress,Oxford,1988.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1		2		3			
CO2	3	2	1			1	3	2	3	2
CO3	2	3	1			1	3	2	2	1
CO4	2	1		1	1		3		2	
CO5	3	2	1				3	2		2
CO6	3	2			1		3			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PE27 POWER ELECTRONICS AND DRIVES LABORATORY L-T-P C
0-0-4 2

Programme: M.E Power Electronics and Drives **Sem: II Category: PC**

AIM: To conduct experiments and enhance understanding of different power electronic controller for power supplies and motor drive applications.

Pre-requisite:

Course Outcomes:

The Students will be able to

CO1. Apply microcontrollers in converters, inverters and choppers
CO2. Apply microcontrollers for speed controlling of motors.
CO3. Understand the driver circuits of PWM
CO4. Design open loop and closed loop control of converter and chopper fed D.C. motor drive.
CO5. Design AC motor controllers
CO6. Design fuzzy based speed controller for AC and DC drivers

LIST OF EXPERIMENTS

1. Micro controller based converter fed dc drive.
2. Micro controller based Chopper fed DC motor Drive
3. Micro controller based inverter fed induction motor Drive.
4. Micro controller based speed control of Stepper motor.
5. Micro controller based Speed control of BLDC motor.
6. DSP based speed control of SRM motor.
7. Study of driver circuits and generation of PWM signals using Microcontroller and FPGA.
8. Simulation of open and closed loop control of converter fed D.C. motor drive.
9. Simulation of open and closed loop control of chopper fed D.C. motor drive.
10. Simulation of VSI Fed 3φInductionMotor Drive.
11. Simulation of 3φSynchronousMotor Drive.
12. Simulation of fuzzy based speed control of AC and DC Drives.

Total Periods 45

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2			1	3			
CO2	3	2	2			1	3	2	1	2
CO3	2	3			1		3			1
CO4	2	3	1				3	3	2	2
CO5	2	3				1	3	3	3	
CO6	2	3				1	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

PROGRAM ELECTIVES

192PEE01 SWITCHED MODE AND RESONANT CONVERTERS L-T-P C
3-0-0 3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To introduce the basic concepts of wind energy conversion systems.

Pre-requisite: Analysis and Design of Power Converters .

Course Outcomes:

The Students will be able to

CO1. Analysis the Steady-State switched-mode dc-dc power converters.
CO2. Design of Switched-Mode Converters, including selection of component values based on steady-state dc and ac ripple specifications.
CO3. Analysis for switched-mode dc-dc converters using averaging techniques,
CO4. Analysis and Design of Control Loops around switched-mode power converters.
CO5. To develop small-signal dynamic models and classical control theory.
CO6. Analysis the design of Pulse Width Modulated Rectifiers.

INTRODUCTION **9**

Design constraints of reactive elements in Power Electronic Systems: Design of inductor, transformer and capacitors for power electronic applications, Input filter design.

PWM DC - DC CONVERTERS **9**

Basic concepts and steady-state analysis of second and higher order Switched Mode power converters: PWM DC - DC Converters (CCM and DCM) - operating principles, constituent elements, characteristics, comparisons and selection criteria

DYNAMIC MODELLING OF SMPC **9**

Dynamic Modelling and control of second and higher order switched Mode power converters: analysis of converter transfer functions, Design of feedback compensators, current programmed, frequency programmed and critical conduction mode control

SOFT-SWITCHING DC - DC CONVERTERS **9**

Soft-switching DC - DC Converters: zero-voltage-switching converters, zero-current- switching converters, Multi- resonant converters and Load resonant converters.

PULSE WIDTH MODULATED RECTIFIERS **9**

Pulse Width Modulated Rectifiers: Properties of ideal rectifier, realization of near ideal rectifier, control of the current waveform, single phase and three-phase converter systems incorporating ideal rectifiers and design examples. Non- linear phenomena in switched mode power converters: Bifurcation and Chaos.

Total Periods 45

Text Books

1. Robert W. Erickson and Dragan Maksimovic, 'Fundamentals of Power Electronics', Springer, 2nd Edition, 2001.
2. 2. Marian K. Kazimierczuk, 'Pulse-width Modulated DC-DC Power Converters' John Wiley & Sons Ltd., 1st Edition, 2008. S.N.Bhadra, D.Kastha,S.Banerjee,"Wind Electrical Sytems",Oxford University Press,2010
3. Philip T Krein, 'Elements of Power Electronics', Oxford University Press, 2nd Edition, 2012.
4. Batarseh, 'Power Electronic Circuits', John Wiley, 2nd Edition, 2004.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2			1		3	3	2	
CO2	2	3				1	3	3	2	2
CO3	3	2			1		3	3	3	1
CO4	3	2			1		3	3	3	1
CO5	2	3	1				3		2	1
CO6	3	2			1		3	3	3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE02 INDUSTRIAL LOAD MODELING AND CONTROL L-T-P C
3-0-0 3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To understand the modeling of load and its ease to study load demand industrially and to know Electricity pricing models

Pre-requisite:

Course Outcomes:

The Students will be able to

CO1. Understand the basics of energy scenario and analyzing various representation of loads
CO2. Know the Electricity pricing models and types of load control
CO3. Study the reactive power management
CO4. Familiarize with industrial processing and control with optimization methodologies
CO5. Recognize different energy saving opportunities in industries
CO6. Apply load management to reduce demand of electricity during peak time.

BASICS OF INDUSTRIAL LOAD CONCEPTS 9

Electric Energy Scenario-Demand Side Management-Industrial Load Management- Load Curves-Load Shaping Objectives-Methodologies- Barriers; Classification of Industrial Loads- Continuous and Batch processes -Load Modeling.

LOAD MODEL AND CONTROL 9

Electricity pricing – Dynamic and spot pricing –Models- Direct load control- Interruptible load control- Bottom up approach- scheduling- Formulation of load models- Optimization and control algorithms - Case studies.

INDUSTRIAL PROCESSING AND CONTROL 9

Reactive power management in industries-controls-power quality impacts- application of filters Energy saving in industries. Cooling and heating loads- load profiling- Modeling- Cool storage-Types- Control strategies- Optimal operation-Problem formulation- Case studies.

ENERGY STORAGE AND GENERATION 9

Captive power units- Operating and control strategies- Power Pooling-Operation models- Energy banking-Industrial Cogeneration

OPTIMAL LOAD MANAGEMENT 9

Selection of Schemes Optimal Operating Strategies- Peak load saving-Constraints-Problem formulation- Case study- Integrated Load management for Industries

Total Periods 45

References

1. C.O. Bjork “Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands, 1989.
2. C.W. Gellings and S.N. Talukdar, “Load management concepts,” IEEE Press, New York, 1986,pp. 3-28.
3. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981.
4. H. G. Stoll, "Least cost Electricity Utility Planning”, Wiley Interscience Publication, USA, 1989.
5. I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi, 1995.
6. IEEE Bronze Book- “Recommended Practice for Energy Conservation and cost effective planning

in Industrial facilities", IEEE Inc, USA.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2		1			3	2	1	1
CO2	1		2		3		3	3	2	1
CO3	3		1		2		3	1	1	1
CO4	1			2	3		3	2		2
CO5	1			2	3		3	1	2	3
CO6	1		2		3		3	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE04 FLEXIBLE AC TRANSMISSION SYSTEMS L-T-P C
3-0-0 3

Programme: M.E. Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: Toprovideaknowledgeofapplicationofpowerelectronicsintheefficientdesignandoperationof power systems.

Course Outcomes:

The students will be able to

CO1. Express the need and basic concepts of flexible AC transmission systems and fundamental idea about the FACTS controllers.
CO2. Realize the influence of SVC on system voltage.
CO3. Recognize the different modes of operation and modeling of TCSC.
CO4. Illustrate the SVC & TCSC applications.
CO5. Demonstrate the operation of Static Synchronous Compensator (STATCOM) modes of operation and modeling of UPFC for power flow studies.
CO6. Understanding the basic concept of custom power devices and its applications.

INTRODUCTION 9

Review of basics of power transmission networks-control of power flow in AC transmission line- Analysis of uncompensated AC Transmission line- Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer- Need for FACTS controllers- types of FACTS controllers.

STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9

Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator –Modelling of SVC for power flow and transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping – Prevention of voltage instability.

THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS 9

Operation of the TCSC – Different modes of operation – Modelling of TCSC – Variable reactance model – Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping-SSR Mitigation.

VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power Transfer-Enhancement of transient stability - Prevention of voltage instability. SSSC-operation of SSSC and the control of power flow –Modelling of SSSC in load flow and transient stability studies. Applications: SSR Mitigation-UPFC and IPFC

CUSTOM POWER DEVICES: AN INTRODUCTION 9

Utility-Customer Interface-introduction to custom power devices -Network reconfiguring devices - Load compensation using DSTATCOM - Voltage regulation using DSTATCOM - Protecting sensitive loads using DVR - Unified power quality conditioner (UPQC) - Custom power park - Status of application of CP devices

Total Periods 45

Text Books

1. R.MohanMathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi- 110 006.

References

1. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008.
2. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.
3. ArindamGhosh,"Power Quality Enhancement Using Custom Power Devices", SPRINGER Science And Business Media, LLC, 2002

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		2		1		3	2	1	1
CO2	2		1		1		3	1	1	3
CO3	2	1		1			3	3	2	1
CO4	1		3		1		3	1	1	1
CO5	1	2				2	3	2	2	1
CO6	2				1		3	2	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE05	**POWER QUALITY**	**L-T-P**	**C**
		3-0-0	**3**

Programme: M.E –Power Electronics and Drives **Sem:** **Category:** **PE**

AIM:
1. To expose the students to the concepts of various power quality issues and its impacts.
2. To know different power quality improvement techniques and devices.

Pre-requisite: Power electronics, Transmission and Distribution

Course Outcomes:

The Students will be able to

CO1. Understand the various power quality issues in power systems.

CO2. Learn the concept of power and power factor in single phase and three phase systems supplying nonlinear loads

CO3. Identify the conventional compensation techniques used for power factor correction and load voltage regulation.

CO4. Understand the active compensation techniques used for power factor correction.

CO5. Explore the active compensation techniques used for load voltage regulation.

CO6. Analyze the various compensation schemes.

INTRODUCTION **9**

Introduction – Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, CBEMA curve and ITIC curve – power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM **9**

Single phase sinusoidal, non sinusoidal source supplying linear and nonlinear loads – Three phase Balance system – Three phase unbalanced system – Three phase unbalanced and distorted source supplying non linear loads – Concept of PF – Three phase three wire.

CONVENTIONAL LOAD COMPENSATION METHODS **9**

Principle of Load compensation and Voltage regulation – Classical load balancing problem: Open loop balancing – Closed loop balancing, Current balancing – Harmonic reduction and voltage sag reduction – Analysis of unbalance – instantaneous real and reactive powers – Extraction of fundamental sequence component.

LOAD COMPENSATION USING DSTATCOM **9**

Compensating single phase loads – Ideal three phase shunt compensator structure – Generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode.

SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM **9**

Rectifier supported Dynamic Voltage Restorer – DC Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified Power Quality Conditioner.

Total Periods **45**

Text Books

1. Arindam Ghosh “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, 2002.
2. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1994. 4 Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, “Power Quality: Problems and Mitigation Techniques”, John Wiley & Sons, 2015.
3. R.C. Duggan, Mark.F.McGranaghan, Surya Santoas and H.WayneBeaty, “Electrical Power System Quality”, McGraw-Hill, 2004.

References

1. Jos Arrillaga and Neville R. Watson, “Power system harmonics”, Wiley, 2003.
2. Derek A. Paice, “Power Electronics Converter Harmonics: Multipulse Methods for Clean Power”, Wiley, 1999.
3. 3. Ewald Fuchs, Mohammad A. S. Masoum Power Quality in Power Systems and Electrical Machines, Elseveir academic press publications, 2011.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1		2		2	3	2			1
CO2	1	2				3	3		2	2
CO3	1		2		2		3	2	2	
CO4	2		1			2	3	2	1	1
CO5	2	1	3				3	2	1	
CO6	2	1	3				2	3		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE06	SPECIAL ELECTRICAL MACHINES	L-T-P	C
		3-0-0	3

Programme: M.E Power Electronics and Drives **Sem: II Category: PC**

AIM: To explore the theory and applications of special electrical machines and its controllers

Course Outcomes:

The Students will be able to

CO1. Elaborate the concepts of stepper motors and its applications.
CO2. Outline the driver system of stepper motors.
CO3. Analyze the concepts of switched reluctance motors and its applications.
CO4. Review the fundamental concepts of permanent magnets and the operation of permanent magnet brushless DC motors.
CO5. Introduce the concepts of permanent magnet synchronous motors and its applications.
CO6. Understand the basic concepts of other special machines and its application.

STEPPER MOTOR **9**

Types - Constructional features – principle of operation – variable reluctance motor (single and Multi-stack configurations) – Permanent Magnet Stepper motor – Hybrid stepper motor- Different modes of Excitation- Other types of stepper motors. Theory of torque predictions – Drive systems and circuit for open-loop and closed-loop control of stepper motor- Comparision& applications of stepper motors.

SWITCHED RELUCTANCE MOTOR **9**

Constructional features – principle of operation –Torque Equation - Power Converters for SR Motor – Rotor Sensing Mechanism & Control of SRM- Current Regulators – Microprocessor Based & Sensorless Control of SR motor – Applications

PERMANENT MAGNET BRUSHLESS DC MOTOR **9**

Construction- Principle of operation – Types – Electronic commutation- comparison of conventional DC & BLDC motor- Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics - Microprocessor Based & Sensorless Control – Applications

PERMANENT MAGNET SYNCHRONOUS MOTOR **9**

Construction- Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics, Self control, Vector control, Current control Schemes – comparison of conventional DC & PMSM motor -Applications.

OTHER SPECIAL MACHINES **9**

Principle of operation and characteristics of Single Phase Special Electrical Machines: AC Series motor, Repulsion motor, Hysteresis motor, Universal motor- servo motor (DC & AC) –Linear motor

Total Periods 45

Text Books

1. E.G.Janardhanan," Special Electrical Machines ", PHI pvt.ltd, 2014.
2. Kenjo T, "Stepping Motors and their Microprocessor Controls", Clarendon Press London, 2003.
3. Miller T J E, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, New Delhi, 1989.

References

1. Naser A and BoldeaL, “Linear Electric Motors: Theory Design and Practical Applications”, Prentice Hall Inc., New Jersey 1987.
2. K. Venkataratnam, “Special Electrical Machines”, Universities Press, India, 2009.
3. Kenjo, T and Naganori, S “Permanent Magnet and brushless DC motors”, Clarendon Press, Oxford, New Delhi, 1989.
4. Floyd E Saner, “Servomotor Applications”, Pittman, London, 1993.
5. William H Yeadon, Alan W Handbook of Small Electric Motors, McGraw-Hill, New Delhi, 2001.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		3	1			3			1
CO2	2	1			1		3	2	2	1
CO3	3	2			1		3	3	2	
CO4	2		1		1		3	2	1	1
CO5	2		1			1	3		2	
CO6	2		2		1		3	2		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE07 MICROCONTROLLER AND DSP BASED SYSTEM DESIGN **L-T-P C**

3-0-0 3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To learn the architecture, programming, interfacing and rudiments of system design of microcontrollers and DSP processor.

Course Outcomes:

The Students will be able to

CO1. Illustrate the architecture of PIC16C7x microcontroller.
CO2. Develop a program using PIC16C7x microcontroller instruction set.
CO3. Enumerate the interrupt system of PIC16C7X.
CO4. Discuss the interfacing of peripherals of PIC16C7X.
CO5. Illustrate the architecture of TMS320LF2407 DSP processor.
CO6. Develop a program using TMS320LF2407 DSP processor instruction set.
CO7. Represent any case study of TMS320LF2407 DSP processor.

PIC 16C7X MICROCONTROLLER **9**

Architecture – memory organization – addressing modes – instruction set – PIC programming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, Introduction to MPLAB.

PERIPHERALS OF PIC 16C7X **9**

Timers – Interrupts, I/O ports- I^2C bus-A/D converter-UART- CCP modules -ADC, DAC and Sensor Interfacing –Flash and EEPROM memories.

MOTOR CONTROL SIGNAL PROCESSORS **9**

Introduction- System configuration registers - Memory Addressing modes - Instruction set – Programming techniques – simple programs.

PERIPHERALS OF SIGNAL PROCESSORS **9**

General purpose Input/output (GPIO) Functionality- Interrupts - A/D Converter-Event Managers (EVA, EVB)- PWM signal generation.

APPLICATIONS OF SIGNAL PROCESSORS **9**

Voltage regulation of DC-DC converters- Stepper motor- Clarke's and park's Transformation-Space vector PWM- Control of Induction Motors.

Total Periods 45

Text Books

1. John B.Peatman, 'Design with PIC Microcontrollers,' Pearson Education, Asia 2004.
2. Hamid A.Toliyat, Steven Campbell, 'DSP based electromechanical motion control', CRC Press 2005.

References

1. Lucio Di Jasio,Tim Wilmshurst, "PIC Microcontrollers", Newnes publications 2008.
2. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ' PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education 2008
3. PIC16F87X datasheet 28/40-pin 8 bit CMOS flash microcontrollers, microchip technology Inc.,2001 and MPLAB IDE Quick start guide, Microchip Technology Inc.,2007.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		3		1		3	2		
CO2	2	3			1		3	3	3	1
CO3	2			1			3	2	2	
CO4	2	3			1		3	2		
CO5	2		3		1		3	2	3	1
CO6	2	3					3	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE09	PULSE WIDTH MODULATION FOR POWER CONVERTERS	L-T-P	C
		3-0-0	3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: Todesignandanalyzethe varioustypesof PWMconvertertopologies.

Pre-requisite: Analysis of Inverter, Power Electronics, Engineering Mathematics

Course Outcomes:

The Students will be able to

CO1. Evaluate the PWM schemes.
CO2. Analysis the methods of PWM.
CO3. Evaluate the Analytic Calculation ofHarmonic Losses.
CO4. Knowledge about modulation Strategies in inverters.
CO5. Represent the space vector modulation.
CO6. Analysis and solution for space vector modulation.

MODULATIONOFONEINVERTERPHASELEG **9**

Fundamental Concept of PWM - Evaluation of PWM Schemes –Double Fourier Integral Analysis of a Two – Level PWM waveform – Naturally Sampled PWM – PWM Analysis by Duty Cycle Variation – Regular Sampled PWM.

MODULATIONOFSINGLE-PHASEVOLTAGESOURCEINVERTERS **9**

Topology of a Single Phase Inverter – Three level Modulation of a Single Phase Inverter - Analytic Calculation of Harmonic Losses – Sideband Modulation Switched Pulse Position – Switched Pulse Sequence.

MODULATIONOFTHREE-PHASEVOLTAGESOURCEINVERTERS **9**

Topology of a Three Phase VSI – Three Phase Modulation with Sinusoidal Reference –Third Harmonic Reference Injection – Analytic Calculation of Harmonic Losses –Discontinuous Modulation Strategies – Triple Carrier Ratios and Sub harmonics.

ZEROSPACEVECTORPLACEMENTMODULATIONSTRATEGIES **9**

Space Vector Modulation – Phase Leg Reference Books for SVM – Naturally Sampled SVM – Analytical Solution for SVM – Harmonic Losses for SVM – Placement of the Zero Space Vector – Discontinuous Modulation.

PROGRAMMEDMODULATIONSTRATEGIES **9**

Optimized Space Vector Modulation – Harmonic Elimination PWM – Performance Index for Optimality – Optimum PWM – Minimum Loss PWM.

Total Periods 45

Text Books

1. D.Grahame Holmes, Thomas A.Lipo,"Pulse Width Modulation For Power Converters; Principles and Practice," JohnWiley&Sons,Inc.,Publications,2003.
2. DorinO.Neacsu, "Power Switching Converters", CRC Press, Taylor & Francis, 2006.
3. Ned Mohan, Undeland and Robbin, "Power Electronics: converters, Application and design" John Wiley and sons.Inc, Newyork, 1999

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		1		2		3	1	2	1
CO2	2				1		3			
CO3	2	3	1				3	2	1	2
CO4	2	1			1		3	2	2	
CO5	2	1					3		2	1
CO6	2				1		3	1	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE10	POWER ELECTRONICS IN POWER SYSTEMS	L-T-P	C
		3-0-0	3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To study and understand the different types of power electronic devices used for power systems applications.

Course Outcomes:

The Students will be able to

CO1. Knowledge about the generation of harmonics and their types.
CO2. Analysis the harmonic filters.
CO3. Evaluate the different control scheme of voltages.
CO4. Knowledge about the VAR compensation.
CO5. Represent the power flow controller schemes.
CO6. Analysis the different schemes of generator excitation and control strategies.
CO7. Illustrate the FACTS controllers.

HARMONICS **9**

HVAC and DC Links- Layout- Types- Generation of Harmonics- Characteristics and non-characteristics harmonics- Troubles caused by harmonics- Harmonic filters- Influence of Harmonics on the operation of drives- Performance evaluation.

PROTECTION OF HVAC/HVDC SYSTEMS **9**

Voltage control- Static tap changers using thyristors- Different control schemes- comparison- Static circuit breakers using thyristors- CBs for HVAC.HVDC systems- Breaking by resonant conditions- characteristics of HRC and semiconductor fuses.

VAR COMPENSATION **9**

VAR compensation- Basic concepts- voltage regulation and power factor correction- phase balancing and power factor correction of unbalanced loads- Properties of static compensator- TCR, TSR, TSC, Modeling and control of thyristor controlled series compensators.

UNIFIED POWER FLOW CONTROLLERS **9**

Unified Power flow Control- Implementation of power flow control using thyristors- Implementation of Unified power flow controller schemes. Static excitation control- Solid state excitation of synchronous generators- Different schemes- Generator excitation- Control Strategies.

FACTS CONTROLLERS **9**

Special purpose FACTS Controller- multifunctional FACTS Controller- Approximate multimodel decomposition- Variable structure FACTS Controller: Non-Linear control- series capacitor control- resistor control.

Total Periods 45

References

1. Begamudre R.D, "EHVAC Transmission Engineering", Wiley Eastern Ltd., 2nd Edition, 1991.
2. Padiyar K.R. "HVDC Power Transmission Systems- Technology", New Age International (P) Ltd., 2nd Edition.
3. Miller T.J.E., "Reactive Power Control in Electrical Systems", Wiley InterScience. New York, 1982.
4. Gyugyi.L, "Unified Power Flow Control Concept for Flexible AC Transmission", IEE Proc-c., Vol 39, 204, July 1992.
5. Narain G. Hingorani, LasizioGyugyi., "Understanding FACTS Concepts and Technology of

Flexible AC Transmission Systems", Standard Publishers Distributors, New Delhi, 2001.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1		2		1		3			1
CO2	3	2			1		3	3	3	1
CO3	3	2	1				3	2	1	2
CO4	1		2		1		3	2		
CO5	2		1			1	3	1		1
CO6	2	1			1		3	3	2	1
CO7	2	1			1		3	1	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE11	SOFT COMPUTING TECHNIQUES	L-T-P	C
		3-0-0	3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To impart knowledge on the emerging area of soft computing techniques, Fuzzy logic systems, artificial neural networks and optimization techniques.

Course Outcomes :

The Students will be able to

CO1. Familiarize the basic concepts of soft computing techniques

CO2. Implement machine learning through neural networks.

CO3. Know about different types of Neural Network

CO4. Understand the concepts of fuzzy logic, fuzzification and de-fuzzification and its algorithmic representation

CO5. Familiarize with popular optimization approaches

CO6. Make conversant with the application of optimization algorithms to real time examples.

INTRODUCTION **9**

Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.

ARTIFICIAL NEURAL NETWORKS **9**

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and recurrent network. Neural Network based controller

FUZZY LOGIC SYSTEM **9**

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.

OPTIMIZATION ALGORITHMS **9**

Modelling of optimization problems- Basic concept of Genetic algorithm and detail algorithmic steps- Simulated Annealing- Particle swarm Optimization-Ant colony search algorithm- Artificial Bee colony algorithms, Cuckoo search Algorithm

APPLICATIONS **9**

Real time application of optimization algorithms, Case studies: Identification and control of linear and nonlinear dynamic systems with GA using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox- an example of temperature control with fuzzy logic controller.

Total Periods 45

Text Books

1. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999.
2. KOSKO, B. "Neural Networks and Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994.
3. KLIR G.J. & FOLGER T.A. "Fuzzy sets, uncertainty and Information", Prentice-Hall of India Pvt. Ltd.,1993.

References

1.StenersonJ., Fundamentals of Programmable Logic Controllers, Sensors and Communications, Prentice Hall,1998.

2.Michel.G and Duncan,F., Programmable Logic Controllers: Architecture and Application, John Wiley&Sons Pvtltd.,1990.

3.Carrow,R.A., SoftLogic: A Guide to Using a PC as a Programmable Logic Controller, Tata McGraw Hill, NewDelhi,1997.

4. Rajesh Kumar Arora., Optimization: Algorithms and Applications, CRC press, Taylor and Francis group Newyork, 2015

5. Pandian Vasant., Handbook of Research on modern optimization algorithms and application in engineering and economics, A volume in Advances in computational Intelligence and Robotics (ACIR) Book Series

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		1		1		2			
CO2	2	3				1	2	3	3	2
CO3	1				2	1	1		2	1
CO4	2	1			1		3	2	1	
CO5	2	1					2	2	3	1
CO6	2		3			1	3	1	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE12 FUNDAMENTALS OF NATURE INSPIRED ALGORITHMS L-T-P C
3-0-0 3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: The intention of this course is to Give an overview of the fundamentals of a special category of algorithms developed from the inspiration of natural things.

Pre-requisite: Calculus, Functions, Linear and Non-linear Function, Discrete and Continuous variables, Maximum and minimum values of continuous function and Discrete function.

Course Outcomes:

The Students will be able to

CO1. Understand the fundamentals of heuristic search algorithms.
CO2. Apply the concept of the natural behavior of agents in the optimization.
CO3. Understand different types of search algorithms.
CO4. Apply the behavior of ant in solving large sized computational problems.
CO5. Understand the basics of population base algorithms.
CO6. Evaluate PSO algorithm with simple examples.

HEURISTIC SEARCH ALGORITHMS 9

Introduction to Heuristic Algorithm – Robustness of traditional optimization and search methods – Goal of optimization – Combinatorial optimization – Problem complexity – Classification of Search algorithms – Nature inspired algorithms – Single point search algorithms – Population based algorithms.

SINGLE POINT SEARCH ALGORITHMS 9

Memory less single point search – Local search – Neighborhood search – Variable neighborhood search – Iterated local search Simulated Annealing – Memory based search algorithms –Tabu search – Hybrid algorithms.

EVOLUTIONARY ALGORITHMS 9

Search algorithm – Genetic algorithm – Coding methods –Phenotype and phenotype representation of solution and mathematical foundation of Genetic Algorithm. Mapping of objective function – Fitness function – Computer implementation of Genetic Algorithm– Data structure – Roulette Wheel selection – Genetic operators – Cross over operators – various types – Mutation operators.

ANT COLONY OPTIMIZATION 9

Advanced Population based search algorithms – Introduction to Ant Colony Optimization – Ant System – Pheromone trail – Desirability factor – Variants in ant colony optimization – Simple applications.

PARTICLE SWARM OPTIMIZATION 9

Swarm intelligence – Particles and swarm – Objective and fitness function – Velocity of particle – Cognition component – Social component – gbest and pbest concept – Evolution of PSO – Simple applications.

Total Periods 45

Text Book

1. David Goldberg, "Genetic Algorithm in search, Optimization and Machine learning", Addison–Weseley Publishers.
2. David Corne, et al. "New Ideas in Optimization" McGraw Hill Publishers. 1999.

References

1. James Kennedy, Russell C. Eberhart, with Yuhui Shi, “Swarm Intelligence”, Morgan Kaufmann, 2001.
2. AndriesEngelbrecht, “Computational Intelligence – an Introduction”, John Wiley and sons Ltd., 2007.
3. 3. Eric Bonabeau, Marco Dorigo, and Guy Theraulaz, “Swarm Intelligence: From Natural to Artificial Systems”, Oxford University Press, 1999.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		2	1		1	2	1	2	2
CO2	2		1	3	1	2	2	2	2	1
CO3	2		1	2			2	3	3	1
CO4	2		1	3		1	2	2	2	
CO5	1	2		1	1		2		1	
CO6	2	1	1	2		1	3	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE13 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION L-T-P C
3-0-0 3

Programme: M.E –Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To expose the students to the concepts of high voltage current transmission.

Pre-requisite: High voltage engineering, Transmission and Distribution

Course Outcomes:

The Students will be able to

CO1. Impart knowledge on operation, modeling and control of HVDC link.
CO2. Perform steady state analysis of AC/DC system.
CO3. Expose various HVDC simulators.
CO4. Exhibit the concepts of the transmission line parameters.
CO5. Analyze the various simulating model for DC link.
CO6. Survive up with the real time applications.

DC POWER TRANSMISSION TECHNOLOGY 9

Introduction - Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system - Planning for HVDC transmission – Modern trends in DC transmission – DC breakers – Cables, VSC based HVDC.

THYRISTOR BASED HVDC CONVERTERS AND HVDC SYSTEM CONTROL 9

Pulse number, choice of converter configuration – Simplified analysis of Graetz circuit - Converter bridge characteristics – characteristics of a twelve pulse converter- detailed analysis of converters. General principles of DC link control – Converter control characteristics – System control hierarchy - Firing angle control – Current and extinction angle control – Generation of harmonics and filtering - power control – Higher level controllers-Valve tests.

MULTITERMINAL DC SYSTEMS 9

Introduction – Potential applications of MTDC systems - Types of MTDC systems - Control and protection of MTDC systems - Study of MTDC systems.

POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Per unit system for DC Quantities - Modeling of DC links - Solution of DC load flow - Solution of AC-DC power flow – Unified, Sequential and Substitution of power injection method

SIMULATION OF HVDC SYSTEMS 9

Introduction – DC LINK Modeling , Converter Modeling and State Space Analysis , Philosophy and tools – HVDC system simulation, Online and Offline simulators — Dynamic interactions between DC and AC systems

Total Periods 45

Text Books

1. J. Arrillaga, “High voltage direct current transmission Book”, The Institution of Electrical Engineers, London, 2nd Edition 1998.
2. Chan-Ki Kim, Gil-Soo Jang, Seok-Jin Lee, Seong-Joo Lim, and Vijay K. Sood “HVDC Transmission: Power Conversion Applications in Power Systems”, IEEE press, John Willey & Sons(Asia) pte., Ltd.,2009

References

1. P. Kundur, “Power System Stability and Control”, McGraw-Hill, 1993
2. K.R.Padiyar, , “HVDC Power Transmission Systems”, New Age International (P) Ltd., New Delhi, 2002

3. J.Arrillaga, , "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983
4. Erich Uhlmann, "Power Transmission by Direct Current", BS Publications, 2004.
5. V.K.Sood, HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2004 , Kluwer Academic Publishers.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	1		2	1	3	2	
CO2	3	2			1	1	2	2	2	
CO3	3	2			1	3	1	2	2	
CO4	1	2		1			2	1	1	1
CO5	3	1			1	2	2	3	2	
CO6			3	2	1	3	2	3	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE14	SMART GRID	L-T-P	C
		3-0-0	3

Programme: M.E –Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To expose the students to the concepts of grid connection

Pre-requisite: High voltage engineering, Transmission and Distribution

Course Outcomes:

The Students will be able to

CO1. Realize Smart Grid technologies, different smart meters and advancement.

CO2. Familiarize the high performance computing for Smart Grid applications.

CO3. Understand the power quality management issues in Smart Grid metering infrastructure.

CO4. Develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

CO5. Acquire knowledge about different smart meters and advanced metering infrastructure.

CO6. Understand the concepts of Smart Grid and its present developments.

INTRODUCTION TO SMART GRID **9**

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, What Should be the Attributes of the Smart Grid? - Why Do We Need a Smart Grid? - Is the Smart Grid a "Green Grid"? Smart Grid Initiative for Power Distribution Utility in India (Term paper).

SMART GRID TECHNOLOGIES **9**

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

SMART METERS AND ADVANCED METERING INFRASTRUCTURE **9**

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

POWER QUALITY MANAGEMENT IN SMART GRID & MICRO GRID **9**

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Micro Grids And Distributed Energy Resources: Concept of micro grid - Need & Applications of micro grid - Formation of micro grid - Issues of interconnection, protection & control of micro grid.

HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS **9**

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

Smart Grid – The New and Improved Power Grid: A Survey By: Xi Fang, IEEE Communications Surveys & Tutorials, VOL. 14, NO. 4, Fourth Quarter 2012.

Total Periods 45

Text Books

1. Stuart Borlase "Smart Grid: Infrastructure, Technology and Solutions", CRC Press 2012.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley 2012.

References

1. Vehbi C. Güngör, DilanSahin, TaskinKocak, SalihErgüt, ConcettinaBuccella, Carlo Cecati, and Gerhard P. Hancke, "Smart Grid Technologies: Communication 38 Technologies and Standards" IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.
2. Xi Fang, SatyajayantMisra, GuoliangXue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey" , IEEE Transaction on Smart Grids, vol. 14, 2012.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1		3		2	2	1			1
CO2	2	1	3	1	1	1	2	2	1	1
CO3	3		1			1	2	2	2	1
CO4	2		3	1	1	1	2	2	2	
CO5	2		3	1		2	3		1	1
CO6	2	1	3		2	2	2	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE15 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS **L-T-P C**

3-0-0 3

Programme: M.E-Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To study about various electrical and power electronic devices used in renewable energy generation systems.

Course Outcomes:

The Students will be able to

CO1. Provide knowledge about the stand alone and grid connected renewable energy systems.
CO2. Ability to equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
CO3. Facility to analyze and comprehend the various operating modes of wind electrical generators and solar energy systems.
CO4. Knowledge to design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
CO5. Ability to develop maximum power point tracking algorithms.
CO6. Ability to design grid connected/standalone renewable energy system employing

INTRODUCTION **9**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) – Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION **9**

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

POWER CONVERTERS **9**

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) – Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers- AC-DC-AC converters, uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

ANALYSIS OF WIND AND PV SYSTEMS **9**

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system- Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system.

HYBRID RENEWABLE ENERGY SYSTEMS **9**

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

Total Periods 45

Text Books

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.
2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi,2009.

References

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.
2. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
3. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.

5. Andrzej M. Trzynnadlowski, 'Introduction to Modern Power Electronics', Second edition, wiley India Pvt. Ltd, 2012.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	1	3	2	3	2	1
CO2	2	1	3		1	1	3	2	2	1
CO3	3	2	2	1		1	2	3		1
CO4	3	1		1	2	1	3	3	2	2
CO5			3	1	2	1	2	2	1	
CO6		2	3	1	2	2	2	2		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE17	WIND ENERGY CONVERSION SYSTEMS	L-T-P	C
		3-0-0	3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To introduce the basic concepts of wind energy conversion systems.

Pre-requisite: Non Conventional energy Resources, Power system analysis, Analysis and Design of Power Converters .

Course Outcomes:

The Students will be able to

CO1. Acquire knowledge on the basic concepts of Wind energy conversion system.

CO2. Understand the mathematical modeling and control of the Wind turbine

CO3. Develop more understanding on the design of Fixed speed system

CO4. Study about the need of Variable speed system and its modeling.

CO5. Able to learn about Grid integration issues and current practices of wind interconnections with power system.

CO6. Outline the grid connected wind energy conversion systems

INTRODUCTION **9**

Components of WECS-WECS schemes -Power obtained from wind-simple momentum theory -Power coefficient- Sabinin's theory -Aerodynamics of Wind turbine

WIND TURBINES **9**

HAWT-VAWT-Power developed -Thrust-Efficiency-Rotor selection -Rotor design considerations -Tip speed ratio -Number of Blades-Blade profile -Power Regulation-yaw control -Pitch angle control-stall control -Schemes for maximum power extraction.

FIXED SPEED SYSTEMS **9**

Generating Systems- Constant speed constant frequency systems -Choice of Generators-Deciding factors -Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model - Generator model for Steady state and Transient stability analysis.

VARIABLE SPEED SYSTEMS **9**

Need of variable speed systems - Power-wind speed characteristics -Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modeling -Variable speed variable frequency schemes.

GRID CONNECTED SYSTEMS **9**

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.

Total Periods 45

Text Books

1. Bin Wu, Yongqiang Lang, NavidZargari, Samir Kouro "Power Conversion and Control of Wind Energy Systems",Wiley , 2011
2. L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990.
3. S.N.Bhadra, D.Kastha,S.Banerjee,"Wind Electrical Sytems",Oxford University Press,2010

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	1	3	3	1		2	1	1	1
CO2	1	3	2	2	2	1	2	2	3	
CO3	2	3	1	1		1	1		2	2
CO4	3	2	2	2	1		2	2	1	2
CO5	2	2	3	2	2	2	1		2	1
CO6	2	2	3	3	2	1	2	2	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE19	DIGITAL CONTROLLERS FOR POWER ELECTRONICS AND DRIVES APPLICATIONS	L-T-P	C
		3-0-0	3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To enrich the learner with digital controller concepts and its application in the field of Power Electronic Systems.

Pre-requisite: Digital Electronics, Digital Signal Processing, Computer Architecture.

Course Outcomes:

The Students will be able to

CO1. Review the DSP architecture, programming methods and their special features as relevant to PE Drives
CO2. Analyze the GPIO multiplexing (MUX) registers and the interrupt concept.
CO3. Understand the functions of ADC and QEP
CO4. Illustrate the operation and applications of Field Programmable Gate Arrays
CO5. Develop programs for the embedded control of electrical drives.
CO6. Provide knowledge about the digital implementation of conventional controllers.

DSP ARCHITECTURE **9**

Introduction to the C2xx DSP core and code generation - The components of the C2xx DSP core - Mapping external devices to the C2xx core - Peripherals and Peripheral Interface - System configuration registers - Memory - Types of Physical Memory - Memory Addressing Modes - Assembly Programming using C2xx DSP - Instruction Set – Software Tools.

MUX AND INTERRUPTS **9**

Pin Multiplexing (MUX) and General Purpose I/O Overview - Multiplexing and General Purpose I/O Control Registers - Introduction to Interrupts - Interrupt Hierarchy - Interrupt Control Registers - Initializing and Servicing Interrupts in Software.

FUNCTIONS **9**

ADC Overview - Operation of the ADC in the DSP - Overview of the Event manager (EV) - Event Manager Interrupts - General Purpose (GP) Timers - Compare Units - Capture Units and Quadrature Enclosed Pulse (QEP) Circuitry - General Event Manager Information.

FPGA **9**

Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA - Xilinx XC3000 series - Configurable logic Blocks (CLB) - Input/Output Block (IOB) – Programmable Interconnect Point (PIP) – Xilinx 4000 series – HDL programming –overview of Spartan 3E and VirtexII pro FPGA boards- case study.

APPLICATIONS **9**

Controlled Rectifier - Switched Mode Power Converters - PWM Inverters - DC motor control - Induction Motor Control.

Total Periods **45**

Text Books

1. Hamid.A.Toliyat and Steven G.Campbell, 'DSP Based Electro Mechanical Motion Control' ,CRC Press New York ,2004.
2. XC 3000 series datasheets (version 3.1). Xilinx, Inc., USA,1998.
3. XC 4000 series datasheets (version 1.6). Xilinx, Inc., USA,1999.
4. Wayne Wolf, 'FPGA based system design', Prentice hall,2004.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	1	3		1	1	3	1		
CO2	3	2	1	1			2	2	1	
CO3	1	2	1		1		2		1	
CO4	1	2	2	3	1	1	3	2	2	1
CO5	2	1	2	1		2	3	2	2	1
CO6	1	2	3		2	2	2	3	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE20 DISTRIBUTED GENERATION AND MICRO-GRIDS L-T-P C
3-0-0 3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To understand the planning and operational issues related to Distributed Generation and Micro- grids.

Course Outcomes:

The Students will be able to

CO1. Represent the Distribution generation.
CO2. Illustrate the Grid integration of Distribution.
CO3. Estimate the Transmission and Distribution systems.
CO4. Evaluate the economic aspects of any distribution system.
CO5. Construct the Principles of various micro-grids.
CO6. Analysis of Micro-grids with multiple DGs.

INTRODUCTION **9**

Need for distributed generation - Renewable sources in distributed generation - Current scenario in distributed generation - Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems.

INTEGRATION OF DGs **9**

Grid integration of DGs – Different types of interfaces - Inverter based DGs and rotating machine based interfaces - Aggregation of multiple DG units - Energy storage elements - Batteries, ultra-capacitors, flywheels.

IMPACTS OF DGs **9**

Technical impacts of DGs – Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems.

ECONOMIC AND CONTROL ASPECTS OF DGs **9**

Market facts, issues and challenges - Limitations of DGs - Voltage control techniques, Reactive power control, Harmonics, Power quality issues - Reliability of DG based systems – Steady state and Dynamic analysis.

MICRO-GRIDS **9**

Introduction to micro-grids – Types of micro-grids – Autonomous and non-autonomous grids – Sizing of micro-grids - Modeling& analysis - Micro-grids with multiple DGs – Micro-grids with power electronic interfacing units - Transients in micro-grids - Protection of micro-grids – Case studies.

Total Periods 45

References

1. H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
2. M.GodoySimoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRCpress.
3. Robert Lasseter, Paolo Piagi, ' Micro-grid: A Conceptual Solution', PESC 2004, June2004.
4. F. Katiraei, M.R. Iravani, 'Transients of a Micro-Grid System with Multiple Distributed Energy Resources', International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-23,2005.
5. 5. Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson, 'Facility Microgrids', General Electric Global Research Center, Niskayuna, New York, Subcontract report, May2005.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1		3		2	1	2			1
CO2	1		3	2			2	1	2	2
CO3	1		3	2	1	1	2	1		
CO4	3	2		1	1	2	2	2		1
CO5	1	2				1	2			
CO6			2	1		3	2	2	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE22	ELECTRIC AND HYBRID VEHICLES	L-T-P	C
		3-0-0	3

Programme:	M.E.-Power Electronics and Drives	Sem:	Category:	PE

AIM: To introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.

Course Outcome:

The students can able to,

CO1. Understand the fundamental concepts of Electric vehicles.
CO2. Analysis hybrid electric drive traction through the Power flow control and fuel efficiency.
CO3. Provide knowledge about configurations and control of various motor drives.
CO4. Matching the electric machine and the internal combustion engine and fully automated using power electronics switches.
CO5. Describe the basics and types of batteries used in electric vehicles
CO6. Categorize energy management strategies in hybrid and electric vehicles.

INTRODUCTION **9**

Electric Vehicles (EV)-Hybrid Electric Vehicles (HEV)-Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.

HYBRID DRIVE-TRAIN **9**

Basic concept of hybrid traction - Introduction to various hybrid drive-train topologies - Power flow control in hybrid drive-train topologies - Fuel efficiency analysis - Basic concepts of electric traction - Introduction to various electric drive-train topologies - Power flow control in hybrid drive-train topologies - Fuel efficiency analysis.

CONTROL AND AUTOMATION OF ELECTRICAL DRIVES **9**

Introduction to electric components used in hybrid and electric vehicles - Configuration and control of DC motor drives - Configuration and control of Induction motor drives - Configuration and control of Permanent Magnet motor drives - Configuration and control of Switch Reluctance motor drives. Matching the electric machine and the internal combustion engine (ICE) - Sizing the propulsion motor

BATTERY ENERGY STORAGE SYSTEM **9**

Basics- Parameters-Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Types-Lead Acid Battery-Lithium ion battery- Lead Acid Battery-Lithium ion Battery-Technical characteristics- Modelling of battery capacity- Calculation of Peukert Coefficient

ENERGY MANAGEMENT STRATEGIES **9**

Introduction to energy management strategies used in hybrid and electric vehicle - Classification of different energy management strategies - Comparison of different energy management strategies - Implementation issues of energy strategies.

Total Periods 45

References

1. Sira -Ramirez, R. Silva Ortigoza, 'Control Design Techniques in Power Electronics Devices', Springer, 2006.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, 'Sliding mode control of switching Power Converters', CRC Press,2011.
3. Iqbal Hussain, "Electric & Hybrid Vehicles: Design Fundamentals", 2 nd Edition, CRC Press, 2011
4. Bimal Bose, 'Power electronics and motor drives', Elsevier,2006.

5. Ion Boldea and S.A Nasar, 'Electric drives', CRC Press,2005.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		3	1		1	3			
CO2	3	1	2			2	3	3	2	1
CO3	1	2		2	3	2	3	2		
CO4	3	2		1		1	3	1	2	
CO5	2	1			2		3			1
CO6	1	2	3	3	2	3	3		1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE23	ADVANCED POWER ELECTRONICS	L-T-P	C
		3-0-0	3

Programme: M.E.-Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To give an introduction to the recent developments of power electronics from components, topology, control techniques to thermal & EMC. This course drives on the application requirements of power electronics. This is a higher level of subject that will help to work in demanding areas of power electronics.

Course Outcome:

The students can able to,

CO1. Suggest suitable power electronic switch from advanced Silicon devices.
CO2. Identify the converter to convert the one form of power sources into various form of power sources.
CO3. Design the reactive elements using advanced magnetic material.
CO4. Propose the capacitive elements using advanced magnetic material.
CO5. Develop to store energy in storage system and capacitors.
CO6. Design a system for thermal engineering with EMI/EMC techniques.

INTRODUCTION TO SWITCHES **9**

Advanced Silicon devices - Silicon HV thyristors, MCT, BRT & EST- SiC devices - diodes, thyristors, JFETs & IGBTs - Gallium nitrate devices - Diodes, MOSFETs.

ADVANCE CONVERTER TOPOLOGIES **9**

Interleaved converters, Z-Source converters, multi level converters (Cascaded H-Bridge, Diode clamped, NPC, Flying capacitor) multi pulse PWM current source converters, advanced drive control schemes.

ADVANCES IN REACTIVE ELEMENTS - **9**

Advanced magnetic material, technology and design (Powder ferrite, Amorphous, Planar designs) Advance capacitive designs (Multilayer chip capacitors, double layers for storage, Aluminum electrolytic).

ADVANCE STORAGE SYSTEMS **9**

Developments in battery systems, Ultra capacitors, Fly wheel energy storage, Hybrid storage systems for EV/HEV, Power management in hybrid systems, Energy storage in renewable.

THERMAL ENGINEERING **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.

Total Periods 45

References

1. Andrzej M Trzynadlowski, ‘Introduction to Modern Power Electronics’, John Wiley and sons. Inc, New York, 1998.
2. R D Middle Brook& Slobodan CUK, 'Advances in Switched Mode Power Conversion', Vol I, II, & III, Tesla Co (optimum power conversion).
3. B. Jayant Balinga, 'Advanced High Voltage Power Device Concepts', Springer New York 2011. ISBN 978 -1- 4614-0268-8.
4. BIN Wu, 'High Power Converters and AC Drives', IEEE press Wiley Interscience, a John Wiley& sons Inc publication2006.

5. WurthElectronics,'Trilogy of Magnetics, Design guide for EMI filter design in SMPS & RF circuits',4th extended and revised edition.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1		3	2		1	3		1	
CO2	2	1			1	1	3	1		2
CO3	1	3	2				3	2	1	
CO4	2	1		3	1		3	2		1
CO5	2	1		3	1	1	3	3	2	1
CO6	1	3	1		2	1	3	2	2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE24	ENERGY STORAGE SYSTEMS	L-T-P	C
		3-0-0	3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **PE**

AIM: To emphasize basic physics, chemistry, and engineering issues of energy storage devices, such as batteries, thermoelectric convertors, fuel cells, super capacitors.

Course Outcomes:

The Students will be able to

CO1. Exposit how energy storage systems can play a role to improve economic, social, and environmental performance of sustainable energy solutions.
CO2. Operate and investigate the performance of selected energy storage solutions while considering the hazards and risks associated with them.
CO3. Apply engineering fundamentals to study the performance of electrical energy storage technologies, such as classical and modern batteries, to support sustainable energy solutions.
CO4. Learn hybridization of various energy conversion devices for vehicle electrification.
CO5. Develop innovative and sustainable solutions for storing and using renewable sources of energy using sustainably super capacitors.
CO6. Identify and explain the working principles of all types of commercially-available energy storage systems such as fuel cells.

TRADITIONAL AND RENEWABLE ENERGY SOURCES **9**

Prospect for both traditional and renewable energy sources - Detailed analysis of Indian energy market and future need through 2020 - Energy, economic growth and the environment, implications of the Kyoto Protocol, and structural change in the electricity supply industry.

BATTERIES **9**

Performance, charging and discharging, storage density, energy density, and safety issues, classical batteries - Lead Acid, Nickel-Cadmium, Zinc Manganese dioxide, and modern batteries - Zinc- Air, Nickel Hydride, Lithium Battery.

THERMOELECTRIC MATERIALS **9**

Thermoelectric - Electron conductor and phonon glass, classical thermoelectric materials - four-probe resistivity measurement, Seebeck coefficient measurement and thermal conductivity measurement.

SUPER CAPACITORS **9**

Types of electrodes and some electrolytes, Electrode materials - High surface area activated carbons, metal oxide and conducting polymers, Electrolyte - Aqueous or organic, disadvantages and advantages of super capacitors - Compared to battery systems, applications - Transport vehicles, private vehicles and consumer electronics - Energy density, power density, price and market.

FUEL CELLS **9**

Direct energy conversion - Maximum intrinsic efficiency of an electrochemical converter, physical interpretation - Carnot efficiency factor in electrochemical energy convertors, types of fuel cells - Hydrogen oxygen cells, hydrogen air cell, alkaline fuel cell and phosphoric fuel cell.

Total Periods 45

References

1. Tetsuya Osaka, MadhavDatta, ‘Energy Storage Systems in Electronics’, Gordon and Breach Science Publishers, 2000.
2. R. M. Dell, D.A.J. Rand, ‘Understanding Batteries’, RSC Publications, 2001.
3. James Larminie, Andrew Dick, ‘Fuel Cell System Explained’, J. Wiley, 2003.

4. D.M. Rowe, 'Thermoelectrics Handbook: Macro to Nano', CRC Press, 2006.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3			1	1			1
CO2	2	3		1			2	2	1	
CO3	3			2	1	1	3	1	1	1
CO4	2	1			1		2		2	
CO5		3	2	1		1	2	2	2	1
CO6		2	1	3		1	1		1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE26 CONDITION MONITORING OF HIGH VOLTAGE POWER APPARATUS **L-T-P C**

3-0-0 3

Programme: M.E.-Power Electronics and Drives **Sem:** **Category:** **PE**

AIM:

Course Outcomes

The Students will be able to

CO1. Explain the general concept of condition monitoring of high voltage power apparatus.
CO2. Describe the condition monitoring in power transformer.
CO3. Perform the power generation condition monitoring.
CO4. Distinguish the idea of various diagnostic techniques and condition monitoring.
CO5. Outline the insulation materials in application area and various testing techniques.
CO6. Explain the high voltage testings.

INTRODUCTION **9**

General concept of condition monitoring – General issues of condition monitoring – Main Components in a condition monitoring system – Condition monitoring techniques.

POWER TRANSFORMER CONDITION MONITORING **9**

Transformer faults and monitoring techniques – Monitoring for on-load tap changer – Insulation monitoring – Sweep frequency response test for condition monitoring – Recent trend/research on Power transformer condition monitoring.

POWER GENERATION CONDITION MONITORING **9**

Power generation faults and monitoring methods – Stator winding faults – Rotor body faults – Rotor winding faults – Stator-core faults – Condition monitoring for generator stator windings.

DIAGNOSTICS AND CONDITION MONITORING **9**

Need for diagnostics and condition monitoring – On-line/on-site testing – Diagnostic tests – Digital techniques – Data acquisition principles and problems – Digital PD measurement – PD as a diagnostic tool – PD pattern – Noise reduction methods – Fault discrimination.

INSULATION MATERIALS AND SYSTEMS **9**

Outdoor insulation: Materials, ageing, diagnostic, polymeric materials, semi-conducting, Ceramic glazes – AC and impulse voltage flashover studies on a string of insulators – RIV and Corona Studies on insulator strings – High voltage testing – Dry, wet and pollution testing.

Total Periods 45

References

1. Naidu M. S. and Kamaraju V., “High Voltage Engineering”, Tata McGraw-Hill, 1995.
2. Kulkarni S.V. and Khaparde S.A., “Transformer Engineering”, Marcel and Dekker Inc., 2004.
3. Tavner P. J. and Penman J., “Condition Monitoring of Electrical Machine”, Letchworth, England,Research Studies Press, Ltd., 1987.
4. Kuffel E., Zaengl W.S. and Kuffel L., “High Voltage Engineering Fundamentals,” Butterworth Heimann, 2nd Edition, 2000.
5. Rao B. K. N., “Handbook of Condition Monitoring”, Elsevier Science Publisher, 1st Edition, 1996.
6. Han Y. and Song Y. H., “Condition Monitoring Techniques for Electrical Equipment – A Literature Survey.” IEEE Trans. on Power Delivery, Vol. 18, No. 1, January 2003.

7. Wadhwa C. L., “High Voltage Engineering”, Wiley Eastern Limited, New Delhi, 1994

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1				2			
CO2	2	3			1		2	1		1
CO3	1	2	3				1	2	2	
CO4	2	3				1	2		1	
CO5	2	1			3		2	2	2	1
CO6	1		1	2	1		1	1		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192PEE27 **FUNDAMENTALS OF NANO TECHNOLOGY** **L-T-P C**

3-0-0 3

Programme: M.E.-Power Electronics and Drives **Sem:** **Category:** **PE**

AIM:

Course Outcomes

The Students will be able to

CO1. Explain crystal lattice structures.
CO2. Memorize the heterostructures and quantum structures.
CO3. Discuss the fabrication of nano structures.
CO4. Describe the characterization techniques.
CO5. Apply the nano technology in science and engineering.

CRYSTALLINE PROPERTIES OF SOLID **9**

Crystal lattice and seven crystal systems – Unit cell concept – Weigner-Seitz cell – Bravais lattices – Space and point groups – Miller indices – Reciprocal lattice – Brillouin zone.

SEMICONDUCTOR HETEROSTRUCTURES AND LOW DIMENSIONAL QUANTUM STRUCTURES **9**

Energy bands, Application of model solid theory – Anderson model for hetero junctions – Multiple quantum wells (MQWs) and super lattices – Two-dimensional nanostructure: quantum well – One dimensional nanostructure: quantum wire – Zero-dimensional nanostructure: quantum dot – Optical properties of low-dimensional structures – Examples and applications in real world.

FABRICATION OF NANO STRUCTURES **9**

Basic compound semiconductors – Bulk single crystal growth techniques – Epitaxial growth techniques – Physical vapour deposition and sputtering – Thermodynamics and kinetics of growths – Nano scale growth modes.

CHARACTERIZATION TECHNIQUES (Qualitative Treatment only) **9**

Structural X-ray diffraction – Electron microscopy – Energy dispersive analysis using X-rays – X-ray photoelectron spectroscopy – Scanning probe microscopy – Optical – Photoluminescence spectroscopy – Absorbance measurement – Raman spectroscopy – Fourier transform spectroscopy.

APPLICATIONS OF NANO TECHNOLOGY **9**

Future of semiconductor device and research – Necessity of innovative technology and prospect for future – Applications in food, energy, transportation, communication, entertainment, health and medicine.

Total Periods 45

References

1. M. Razeghi, “Fundamentals of Solid State Engineering”, 2nd Edition, Springer, 2006.
2. K.K.Chattopadhyay, A.N. Banerjee, “Introduction to Nanoscience and Nanotechnology”, PHI Learning Private Limited, 2011.
3. W. R. Fahrner, “Nanotechnology and Nano electronics: Materials, Devices, Measurement Techniques”, Springer-Verlag Berlin Heidelberg, 2005.
4. R. W. Kelsall, I. W. Hamley, and M. Geoghegan, “Nano scale Science and Technology”, John Wiley & Sons Limited, England, 2005.
5. M.A.Shah, Tokeer Ahmad, “Principles of Nano science and Nanotechnology”, Narosa Publishing

home Private Limited, 2010.
6. B.Viswanathan, “Nano materials”, Narosa Publishing home Private Limited, 2009.
7. William Illsey Atkinson, “Nanotechnology”, Jaico Publishing Home, 2008.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		1				3	1		
CO2	2	1			1		3			
CO3	1		2			1	2		2	
CO4	2			1	1	2	2	2		1
CO5	3		1		1	1	2	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

OPEN ELECTIVE

192OE01	BUSINESS ANALYTICS	L-T-P	C
		3-0-0	3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **OE**

AIM: To Familiarize Z-Transform and design the discrete time nonlinear control systems.

Pre-requisite: Protection and switch gear

Course Outcomes:

The Students will be able to

CO1. Understand the role of business analytics within an organization.

CO2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.

CO3. To become familiar with processes needed to develop, report, and analyze business data.

CO4. Use decision-making tools/Operations research techniques.

CO5. Manage business process using analytical and management tools.

CO6. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

INTRODUCTION **9**

Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

TRENDINESS AND REGRESSION ANALYSIS **9**

Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

BUSINESS ANALYTICS PROCESS **9**

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

FORECASTING TECHNIQUES **9**

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

DECISION ANALYSIS **9**

Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Total Periods 45

References

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		1		1		2			1
CO2	1				1	1	2	3		1
CO3	1		2				2			1
CO4	1		1	1	1		2	2		
CO5	3		1				2			1
CO6	2	1	1		1	1	3	3		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE02	INDUSTRIAL SAFETY	L-T-P	C
		3-0-0	3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **OE**

AIM: To provide exposure about safety and health provisions related to hazardous processes in Industry.

Pre-requisite: Protection and switch gear

Course Outcomes:

The Students will be able to

CO1. Ability to understand the safety concept and safety policy.
CO2. Monitor and calculate the safety performance
CO3. Recognize different hazardous zones in Industries
CO4. Select the suitable electrical equipment in different hazard zone
CO5. Understand the health and welfare provisions in Industries.
CO6. Prepare onsite and offsite emergency plan and understand the factories act.

SAFETY CONCEPTS AND TECHNIQUES **9**

Evaluation of modern safety concept – Safety policy – Safety organization - line and staff functions for safety – safety committee – budgeting for safety- Incident Recall Technique (IRT)- Safety survey – Safety inspection, sampling and Auditing

SAFETY PERFORMANCE MONITORING **9**

Reactive and proactive monitoring techniques – Permanent total disabilities – Permanent partial disabilities, temporary total disabilities – Calculations of accident indices, frequency rate, severity rate, accident rate – safety t score, safety activity rate –Medical Examination Record

ELECTRICAL HAZARDS AND PROTCTION IN INDUSTRY **9**

Primary and secondary hazards – shocks, burns, scalds, falls – Energy leakage – Current surges – over current and short circuit current - Heating effects of current – corona effect – electrical causes of fire and explosion- fuse – circuit breaker – lightning arrester – earth resistance, earth pit maintenance – earth fault protection – Personal protective equipment- safety in handling hand held electrical appliances tools.

VENTILATION AIR CONDITIONING AND NOISE **9**

Legal requirements – Purpose of ventilation – Methods of ventilation – Sources of ventilation – Air cleaning – Air conditioners – Types and maintenance – Noise control and sound absorption –vibration isolation – sources of vibration – vibration prevention and measurement

SAFETY HANDLING SYMBOLS AND ACTS **9**

Workplace – Emergency planning and Handling – Development of Emergency action plan-Onsite and Offsite – Fire Emergency procedure- Safety Signs and Safety Color used in Industry-Training and maintenance – Under Safety and health of Factories Act 1948 - Penalties and Procedures – Tamilnadu Factories Rules 1950

Total Periods 45

Text Books

1. A.K. Gupta “Industrial Safety and Environment”, University Science Press,2015
2. Heinrich H.W. “ Industrial Accident Prevention” McGraw-Hill Company, New York 1980

References

1. “Accident Prevention Manual for Industrial operations” N.S.C.Chigago 1982.
2. John Cadick , “ Electrical Safety handbook”Third Edition Mc Graw Hill 2006.
3. Krishnan N.V, “ Safety Management in Industry” Jaico Publishing House, Bombay 1997.
4. Tha Factories Act 1948, Madras Book Agency, Chennai 2000.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1		1			1	2			3
CO2		1					2	2		2
CO3	2	2	1		1	1	2	2	2	1
CO4	3	1	2	3	1	1	2		3	1
CO5	1			1	1	2	2			1
CO6	1	1	1		1	2	2	1		2

192OE03	**OPERATION RESEARCH**	**L-T-P**	**C**
		3-0-0	**3**

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **OE**

AIM:

Course Outcomes:

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

CO1. Apply the dynamic programming to solve problems of discreet and continuous variables.
CO2. Apply the concept of non-linear programming.
CO3. Carry out sensitivity analysis
CO4. Model the real world problem and simulate it.
CO5. Schedule the tasks as per given time period.
CO6. Understand the dynamic programming and game theory techniques.

UNIT I **9**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

UNIT II **9**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT III **9**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PER

UNIT IV **9**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V **9**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Total Periods **45**

References

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	2	1	1	2	2		1
CO2	2	2					2	1		
CO3	1	1					1	1		
CO4	2	1	1	2	1	1	2	3	2	1
CO5	1	1	2			1	2	1		1
CO6	1	1	2	2			3	1		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE04	DESIGN OF EXPERIMENTS	L	T	P	C
		3	0	0	3

Programme: M.E. Power Electronics and Drives **Sem:** **Category:** **OE**

Aim: To design the experiments and analyze data collected from experiments

Course Outcomes: The Students will be able to

CO1: Familiarize the Fundamentals of design of experiments

CO2: Practice the various tools used in DOE

CO3: Conduct experiments based on factorial design

CO4: Impart the concepts of Taguchi technique

CO5: Apply for product/process optimization

FUNDAMENTALS OF DESIGN OF EXPERIMENTS **9**

Basic principles of design of experiment – randomization – replication – interactions - simple comparative experiments - applications of experimental design - barriers in DOE - practical methodology

ANALYTICAL TOOLS OF DOE **9**

Main effects plot - Interactions plots - Cube plots - Pareto plot of factor effects - Normal Probability Plot of factor effects - Response surface plots and regression models - Model building – Analysis of variance

FACTORIAL DESIGNS **9**

Single factor experiments - Latin square designs and extensions –Introduction to factorial designs, two levels, 2^k factorial designs - Fractional factorial designs, two-level, three-level and mixed-level factorials

TAGUCHI APPROACH **9**

Overview of Taguchi approach - common experiments and methods of analysis. Orthogonal array- properties - Degrees of freedom-confidence level and interval – case study exercises.

PARAMETER OPTIMIZATION **9**

Regression models - parameter optimization – single and multi objective optimization - Response surface methodology – grey relational analysis – complex proportional assessment of alternatives (COPRAS) - case study exercises

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Douglas C. Montgomery, "Designand Analysis of Experiments", 5th edition., Wiley. 2001
2. Jiju Antony, " Design of Experiments for Engineers and Scientists", 2nd Edition, Elsevier, Londan, 2014.
3. Lennart Eriksson, " Design of Experiments: Principles and Applications", Umetrics Academy, Sweedan, 2008
4. Oehlert, GaryW. "First Course in Design and Analysis of Experiments", Freeman Publishers, New York, 2000
5. Ranjit K Roy, Design of Experiments using the Taguchi Approach, John Wiley & sons, Inc., 2001

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1		1				2			
CO2	2	1					1			
CO3	2				1		1	2		
CO4	1	2					2	1		
CO5	1	1					3			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE05	**COMPOSITE MATERIALS**	**L-T-P**	**C**
		3-0-0	**3**

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **OE**

Course Outcomes:

CO1. Identify, describe and evaluate the properties of fibre reinforcements, polymer matrix materials and commercial composites.
CO2. Develop competency in one or more common composite manufacturing techniques, and be able to select the appropriate technique for manufacture of fibre-reinforced composite products.
CO3. Analyse the elastic properties and simulate the mechanical performance of composite laminates; and understand and predict the failure behaviour of fibre-reinforced composites
CO4. Apply knowledge of composite mechanical performance and manufacturing methods to a composites design project
CO5. Critique and synthesise literature
CO6. Apply the knowledge gained from the course in the design and application of fibre-reinforced composites.

INTRODUCTION **9**

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

REINFORCEMENTS **9**

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

COMPOSITES **9**

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique,Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

PREPARATION OF MOULDING **9**

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications

STRENGTH DESIGN **9**

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Total Periods 45

Text Books

1. R.W.Cahn , "Material Science and Technology " Composites – VCH, West Germany,1994.
2. WD Callister, Jr., Adapted by R.Balasubramaniam, "Materials Science and Engineering, An introduction", John Wiley & Sons, NY, Indian edition, 2007.
3. Deborah D.L. Chung, "Composite Materials Science and Applications" Springer London, 2012.
4. Danial Gay, Suong V. Hoa, and Stephen W.Tasi "Composite Materials Design and Applications", 2014.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	2			1			
CO2	3	3	1	2			1		1	
CO3	2	3	2	1			2	3		
CO4	2	1	3	1			1	1		
CO5	1	2	3	2			1		1	
CO6	2	1	3	2			1		1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE06	**COST MANAGEMENT OF ENGINEERING PROJECTS**	**L-T-P**	**C**
		3-0-0	**3**

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **OE**

AIM: To develop the knowledge and skills required to administer and manage projects effectively in a specific discipline of engineering

Pre-requisite:

Course Outcomes:

The Students will be able to

CO1. Demonstrate an understanding of, and apply, the fundamentals of project planning and project management.

CO2. Prepare and evaluate cost estimates, tender documentation and contract documentation.

CO3. Administer and supervise contracts in accordance with the relevant Standards and/or Codes of Practice

CO4. Critically evaluate professional practice principles and their application to an engineering environment.

CO5. Contract law and Documentation, schedules of Quantities, costing and Tendering, time cost/quality balance, contract types, engineering company structures

CO6. Apply the concepts into Engineering projects

INTRODUCTION **9**

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making. Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning.

PROJECT EXECUTION **9**

Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

PROFIT PLANNING & TARGET COSTING **9**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.

TOTAL QUALITY MANAGEMENT **9**

Just-in-time approach, Material Requirement

Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

QUANTITATIVE TECHNIQUES **9**

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Total Periods 45

References

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		1			1	2			
CO2	1						2	2	1	
CO3							1			
CO4	1						2			
CO5							3	1		
CO6	2	1	1			1	3	1		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE07	WASTE TO ENERGY	L-T-P	C
		3-0-0	3

Programme: M.E Power Electronics and Drives **Sem:** **Category:** **OE**

AIM: To deal with the production of energy from different types of wastes through thermal, biological and chemical routes.

Course Outcomes:

CO1. Describe the nature and principle of different biomass energy extraction systems and know how to choose the suitable biomass fuels for different bio-energy applications;
CO2. Distinguish the desirable features of these biomass energy sources and their advantages over traditional fuels such as coal and oil
CO3. Identify their limited scope in terms of suitable sites, dependence on the elements, capital costs, and cost effectiveness compared with traditional sources.
CO4. Get acquainted with the environmental impacts of energy technologies.
CO5. Acquire scientific and technological understanding on the energy resources
CO6. Identify the issues associated with energy crisis

INTRODUCTION **9**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

BIOMASS PYROLYSIS **9**

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

BIOMASS GASIFICATION **9**

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

BIOMASS COMBUSTION **9**

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

BIOGAS **9**

Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Total Periods 45

References

1. Desai, Ashok V., “Non Conventional Energy”, Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. and Mahdi, S. S., “ Biogas Technology - A Practical Hand Book” Vol. I &II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Challal, D. S., “Food, Feed and Fuel from Biomass” IBH Publishing Co. Pvt. Ltd., 1991.
4. C. Y. WereKo-Brobby and E. B. Hagan, “Biomass Conversion and Technology” John Wiley &Sons, 1996.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1						2		1	
CO2	1						2			
CO3	2						1		1	
CO4	2			1			2	2		
CO5	3			1	1	1	3			
CO6	1			1		1	1	2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE08	**NANOMATERIALS AND NANOTECHNOLOGY**	**L-T-P**	**C**
		3-0-0	**3**
Programme:	M.E Power Electronics and Drives	**Category:**	**OE**

Prerequisites: Nil

Aim: To understand the basics of nano materials and its technology

Course Outcomes:

The Students will be able to

CO1. Acquire the knowledge of the representatives of Nano particles and Characteristic techniques of nano materials.

CO2. Familiar with new trends in engineering, namely nanotechnology and nanofabrication and with their applications in modern industries.

CO3. Get the knowledge in the field of nanotechnology and nano materials.

CO4: Practice the nano electronics

CO5: Familiarize nano heat transfer

ZERO – DIMENSIONAL NANOSTRUCTURES **9**

Nanoparticles through homogenous nucleation, nanoparticles through the heterogeneous nucleation, kineticallyconfined synthesis of nanoparticles, epitaxial core – shell nanoparticles. One Dimensional Nanostructure-Nanowires And Nanorods: Spontaneous growth, template based synthesis, electro spinning, and lithography.

TWO-DIMENSIONAL NANOSTRUCTURES-THIN FILMS **9**

Fundamentals of film growth, vacuum science, physical vapor deposition (PVD), Chemical VaporDeposition(CVD), Atomic Layer Deposition (ALD), Electrochemical Deposition, Sol-Gel films.

NANOSTRUCTURES FABRICAITON **9**

Lithography, nano manipulation and nanolithography, soft lithography, assembly of nanoparticels andnanowires, other methods of micro fabrication, Scanning Electron Microscope. Nanomechanics: A high speed review of motion: Displacement, velocity, acceleration and force, nano mechanical oscillation, feeling faint forces.

NANO ELECTRONICS: ELECTRON ENERGY BANDS, ELECTRONS IN SOLIDS **9**

Conductors, insulation and semi conductors, fermi energy, the density of states for solids, quantumconfinement, tunneling, single electron phenomenon, molecular electronics. Nanophotonics: Photonics properties of nanomaterials, near-field light, optical tweezers, photonic crystals.

NANO SCALE HEAT TRANSFER **9**

Nanoscale heat, conduction, convection, radiation. Nanoscale Fluid Mechanics: Fluids at the nanoscale: major concepts, flow fluids flow at the nanoscale, applications of nanofludics

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Ben Rogers, Pennathur and Adams, Nanotechnology: Understanding Small System, CRC Press, 2008.
2. Bhushan, Bharat (Ed.) Handbook of Nanotechnology, Springer 2006.
3. Guozhong Cao, Nanostructures and Nanomaterials, Imperial College Press, 2006.
4. Lundstrom, Mark, Guo, Jing, Nanoscale transistors, Device physics, modeling and simulation,Springer,2006.
5. Yury Gogotsi, Nanomaterials Handbook, Drexel University, Philadelphia, Pennsylvania, USA, 2006.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	2					2			
CO2	1	1					2		1	
CO3	2						1		1	
CO4	1		1				2		2	
CO5	1		1				3			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

AUDIT COURSES

192AC01	CONSTITUTION OF INDIA	L-T-P	C
		2-0-0	0

Programme: M.E Power Electronics and drives **Sem:** **Category:** **MC**

AIM: Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

Course Outcomes:

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.

CO3. Informed the conceptualization of social reforms leading to revolution in India.

CO4. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO5. Discuss the passage of the Hindu Code Bill of 1956.

CO6. Understand the role of Election commission

HISTORY OF MAKING OF THE INDIAN CONSTITUTION **6**

History ,Drafting Committee, (Composition & Working)

PHILOSOPHY OF THE INDIAN CONSTITUTION **6**

Preamble, Salient Features

CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES **9**

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.

ORGANS OF GOVERNANCE **6**

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

LOCAL ADMINISTRATION **9**

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

ELECTION COMMISSION **9**

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

Total Periods 45

References

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	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1						2				3
CO2						2				3
CO3						3				2
CO4						3				2
CO5						3				2
CO6						3				1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC02	DISASTER MANAGEMENT	L-T-P	C
		2-0-0	0

Programme: M.E Power Electronics and drives **Sem:** **Category:** **MC**

AIM: To through knowledge, experience and research build capacities that will reduce disaster risks and contribute to better and more targeted public health based relief following disasters.

Course Outcomes:

Students will be able to:

CO1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO4. Critically understand the strengths and weaknesses of disaster management approaches.
CO5. Planning and programming according to the situation.
CO6. Identify risk and mitigation during the time of disaster.

INTRODUCTION **6**

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

REPERCUSSIONS OF DISASTERS AND HAZARDS **9**

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Manmade disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

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.

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.

RISK ASSESSMENT **9**

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.

DISASTER MITIGATION **9**

Meaning, Concept and Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Total Periods 45

References

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company, 2014.
2. Sahni, PardeepEt.Al. (Eds.), "Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi, 2001.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" , Deep &Deep Publication Pvt. Ltd., New Delhi, 2009.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1						3				3
CO2						3				1
CO3						2				1
CO4						3				2
CO5						1				3
CO6						2				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC03	**ENGLISH FOR RESEARCH PAPER WRITING**	**L-T-P**	**C**
		2-0-0	**0**

Programme: M.E Power Electronics and drives **Sem:** **Category:** **MC**

AIM: To learn the skills required for Research paper writing

Course Outcomes:

Students will be able to:

CO1. Understand that how to improve your writing skills and level of readability
CO2. Learn about what to write in each section
CO3. Understand the skills needed when writing a Title
CO4. Ensure the good quality of paper at very first-time submission
CO5. Examine the writing skills
CO6. Verity the manuscript for first time submission.

INTRODUCTION **9**

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

CLARIFICATION **9**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

LITERATURE SURVEY **9**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

ESSENTIAL SKILLS **9**

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

VERIFICATION **9**

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.

Total Periods 45

References

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

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1						2				3
CO2						3				2
CO3						3				2
CO4						1				2
CO5						2				2
CO6						3				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC04 SANSKRIT FOR TECHNICAL KNOWLEDGE L-T-P C
2-0-0 0

Programme: M.E Power Electronics and drives **Sem:** **Category:** **MC**

AIM: To Learn Sanskrit through Technical Education

Course Outcomes:

Students will be able to

CO1. Understanding basic Sanskrit language
CO2. Get a working knowledge in illustrious Sanskrit, the scientific language in the world
CO3. Learn of Sanskrit to improve brain functioning
CO4. Develop the logic in mathematics, science & other subjects enhancing the memory power.
CO5. Ancient Sanskrit literature about science & technology can be understood
CO6. Being a logical language will help to develop logic in students

UNIT I **15**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

UNIT II **15**

Order, Introduction of roots, Technical information about Sanskrit Literature

UNIT III **15**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Total Periods 45

References

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi.
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1						3				1
CO2						3				1
CO3						3				1
CO4						2				1
CO5						2				1
CO6						1				1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC05 **VALUE EDUCATION** **L-T-P** **C**
2-0-0 **0**

Programme: M.E Power Electronics and drives **Sem:** **Category:** **MC**

AIM: To Understand value of education and self- development

Course Outcomes:

Students will be able to:

CO1. Knowledge of self-development
CO2. Learn the importance of Human values
CO3. Develop the overall personality
CO4. Identify moral and ethics of value Education
CO5. Avoid fault thinking
CO6. Know about the role of human values and equality

MORALS AND ETHICS **9**

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation. Standards and principles, Value judgments.

CULTIVATION OF VALUES **12**

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.

PERSONALITY AND BEHAVIOR DEVELOPMENT **12**

Personality and Behavior Development - 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-True friendship-Happiness Vs suffering, love for truth-Aware of self-destructive habits- Association and Cooperation-Doing best for saving nature.

SCIENCE OF REINCARNATION **12**

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

Total Periods **45**

References

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1						2				3
CO2						3				3
CO3						1				3
CO4						3				3
CO5						2				3
CO6						1				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC06	PEDAGOGY STUDIES	L-T-P	C
		2-0-0	0

Programme: M.E Power Electronics and drives **Sem:** **Category:** **MC**

AIM: To review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers

Course Outcomes:

Students will be able to:

CO1. Create a connection between teaching and learning, between professors and students
CO2. Take much of the guessing out of the student's attempt to learn
CO3. Enable them to truly master the content of the course
CO4. Analyze different teaching approaches from teaching students to memorize.
CO5. Describe the measurable skills, abilities, knowledge or values
CO6. Demonstrate as a result of a completing a course

INTRODUCTION AND METHODOLOGY **4**

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.

THEMATIC OVERVIEW **2**

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

PEDAGOGICAL PRACTICES **4**

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, 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, Teachers' attitudes and beliefs and Pedagogic strategies.

PROFESSIONAL DEVELOPMENT **4**

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

RESEARCH GAPS AND FUTURE DIRECTIONS **2**

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

Total Periods 16

References

1. Ackers J, Hardman F "Classroom interaction in Kenyan primary schools", Compare, 31 (2): 245-261, 2001.
2. Agrawal M "curricular reform in schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361-379,2004.
3. Akyeampong K , Teacher training in Ghana - does it count? Multi-site teacher education research" ,2003.project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J " Improving teaching and learning of basic maths

and reading in Africa: Does teacher preparation count?" International Journal Educational Development, 33 (3): 272–282,2013.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1						2				2
CO2						3				2
CO3						3				1
CO4						3				1
CO5						2				2
CO6						2				2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC07 STRESS MANAGEMENT BY YOGA L-T-P C
2-0-0 0

Programme: M.E Power Electronics and drives **Sem:** **Category:** **MC**

AIM: To achieve overall health of body and mind

Course Objectives: To Develop healthy mind in a healthy body thus improving social health also Improve efficiency

Course Outcomes:

Students will be able to:

CO1. Develop healthy mind in a healthy body thus improving social health
CO2. Classify Yoga Ashtanga
CO3. Learn Do`s and Don't's in life
CO4. Differentiate between Yam and Niyam
CO5. Regularize of breathing techniques
CO6. Implement various yog poses and their benefits for mind and body

UNIT I **8**

Definitions of Eight parts of yoga. (Ashtanga)

UNIT II **8**

Yam and Niyam.
Do`s and Don't's in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III **8**

Asan and Pranayam
i) Various yog poses and their benefits for mind & body
ii)Regularization of breathing techniques and its effects-Types of pranayam

Total Periods 24

References

1. Janardan Swami Yogabhyasi Mandal "Yogic Asanas for Group Tarining-Part-I" , Nagpur , 2014.
2. "Rajayoga or conquering the Internal Nature" Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1						3				3
CO2						3				2
CO3						2				2
CO4						2				2
CO5						2				2
CO6						1				2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC08 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS **L-T-P C**

2-0-0 0

Programme: M.E Power Electronics and drives **Sem:** **Category:** **MC**

AIM: To become a person with stable mind, pleasing personality and determination

Course Outcomes:

Students will be able to:

CO1. Study of Shrimad-Bhagwad-Geeta
CO2. Develop personality and achieve the highest goal in life.
CO3. Lead the nation and mankind to peace and prosperity.
CO4. Study of Neetishatakam for developing versatile personality
CO5. Learn Do`s and Don't's in life
CO6. Approach day to day work and duties

UNIT I **8**

Neetisatakam-Holistic development of personality,Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue), Verses- 52,53,59 (dont's), Verses- 71,73,75,78 (do's)

UNIT II **8**

Approach to day to day work and duties, Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17,23, 35, Chapter 18-Verses 45, 46, 48.

UNIT III **8**

Statements of basic knowledge, Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68, Chapter 12 - Verses 13, 14, 15, 16,17, 18, Personality of Role model, Shrimad Bhagwad Geeta:Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39,Chapter18 – Verses 37,38,63

Total Periods 24

References

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1						2				2
CO2						3				3
CO3						3				3
CO4						2				2
CO5						2				2
CO6						3				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)