VINAYAKA MISSIONS UNIVERSITY

SALEM, TAMILNADU, INDIA

FACULTY OF ENGINEERING AND TECHNOLOGY

REGULATIONS - 2015

CURRICULUM AND SYLLABUS

FROM

I TO VI SEMESTERS

FOR

M.E. POWER ELECTRONICS AND DRIVES (REGULAR)

VINAYAKA MISSIONS UNIVERSITY, SALEM

FACULTY OF ENGINEERING AND TECHNOLOGY

M.E (POWER ELECTRONICS AND DRIVES-REGULAR)

REGULATION 2015

YEAR I

SEMESTER I

S.No	Subject Name	L	T	P	C
Theory					
1	Applied Mathematics for Electrical Engineers	3	1	0	4
2	System Theory	3	1	0	4
3	Analysis of Power Converters	3	0	0	3
4	Analysis of Inverters	3	0	0	3
5	Computer Aided Design of Electrical Machines	3	1	0	4
6	Elective – I	3	0	0	3
Practical					
7	Power Electronics Simulation I Lab	0	0	3	2
	TOTAL	**18**	**3**	**3**	**23**

SEMESTER II

S.No	Subject Name	L	T	P	C
Theory					
1	Digital Signal Processing	3	1	0	4
2	Solid State DC Drives	3	1	0	4
3	Solid State AC Drives	3	1	0	4
4	Micro-Controller Based System Design	3	0	0	3
5	Elective – II	3	0	0	3
6	Elective – III	3	0	0	3
Practical					
7	Power Electronics Simulation II Lab	0	0	3	2
	TOTAL	**18**	**3**	**3**	**23**

YEAR II

SEMESTER III

S.No	Subject Name	L	T	P	C
Theory					
1	Elective – IV	3	0	0	3
2	Elective – V	3	0	0	3
3	Elective – VI	3	0	0	3
4	Project Work – Phase - I	0	0	12	6
	TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

S.No	Subject Name	L	T	P	C
Theory					
1	Project Work – Phase - II	0	0	24	12
	TOTAL	**0**	**0**	**24**	**12**

TOTAL CREDITS : 73

LIST OF ELECTIVES

S.No	Subject Name	L	T	P	C
Theory					
1	Microprocessor Application in Power Electronics	3	0	0	3
2	Special Machines And Controllers	3	0	0	3
3	Advanced Semiconductor devices and their Applications	3	0	0	3
4	Flexible AC Transmission Systems	3	0	0	3
5	Computer Network Engineering	3	0	0	3
6	Software for Electromagnetic Design	3	0	0	3
7	Software for Circuit Simulation	3	0	0	3
8	Software for Control Systems Design	3	0	0	3
9	Digital Instrumentation	3	0	0	3
10	Theory and Design of Neuro-Fuzzy Controllers	3	0	0	3
11	Design of Intelligent Controllers	3	0	0	3
12	Object Oriented Programming and its Applications to Electrical Engineering	3	0	0	3
13	High Voltage Direct Current Transmission	3	0	0	3
14	Power Electronics for Renewable Energy Systems	3	0	0	3

SYLLABUS

YEAR	SEMESTER	TITLE OF PAPER	L	T	C
I	I	APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS	3	1	4
AIM	The aim of this course is to introduce students to the types of problems encountered in matrix theory, to provide techniques to analyze and solve these problems, and to provide examples of where these techniques are used in practice.				
OBJECTIVE	➢ Develop their understanding of random processes particularly as they apply to electrical systems. ➢ Understand the concept of probability space, and different interpretations of probability. ➢ Understand the modeling of physical systems using the tools of multivariate random processes. ➢ Understand and characterize the output of linear systems excited by random processes. ➢ Understand how the slope of the objective function relates to the solution.				

UNIT I - ADVANCED MATRIX THEORY 9

Matrix norms – Jordan canonical form – Generalised eigenvectors – Singular value decomposition – Pseudo inverse – Least square approximations – QR algorithm.

UNIT II - CALCULUS OF VARIATIONS 9

Variation and its properties – Euler's equation – Functionals dependent on first and higher order derivatives – Functionals dependent on functions of several independent variables – Some applications – Direct methods: Ritz and Kantorovich methods.

UNIT III - LINEAR PROGRAMMING 9

Basic concepts – Graphical and Simplex methods –Transportation problem – Assignment problem.

UNIT IV - DYNAMIC PROGRAMMING 9

Elements of the dynamic programming model – optimality principle – Examples of dynamic programming models and their solutions.

UNIT V - RANDOM PROCESSES 9

Classification – Stationary random processes – Auto Correlation – Cross Correlations – Power spectral density – Linear system with random input – Gaussian Process.

L = 45 : T = 15: Total Hours=60

REFERENCES

1. Lewis.D.W.,Matrix Theory ,Allied Publishers, Chennai 1995.
2. Bronson, R, Matrix Operations, Schaums outline Series, McGraw Hill, New York. 1989.
3. Elsgoltis, " Differential Equations and Calculus of Variations ", MIR Publishers, Moscow (1970)
4. Gupta.A.S.,Calculus of Variations with Applications ,Prentice Hall of India, New Delhi, 1999.
5. Taha, H.A., "Operations research - An Introduction ", Mac Millan publishing Co., (1982).
6. Gupta, P.K.and Hira, D.S., "Operations Research ", S.Chand & Co., New Delhi, (1999).
7. Ochi, M.K. "Applied Probability and Stochastic Processes ", John Wiley & Sons (1992).
8. Peebles Jr., P.Z., "Probability Random Variables and Random Signal Principles ", McGraw Hill Inc., (1993).

YEAR	SEMESTER	TITLE OF PAPER	L	T	C
I	I	SYSTEM THEORY	3	1	4
AIM	To equip the students with knowledge of Control system techniques, recent methods and it's required for the analytical study of the technical subjects under Power Electronics and power systems.				
OBJECTIVE	To Study About Frequency Domain concepts To study about state space condition To understand non linear systems and its characteristics To study the stability concept				

1. FREQUENCY DOMAIN DESCRIPTIONS 9

Properties of Transfer functions - Impulse response matrices - Poles and Zeros of transfer function matrices -critical frequencies - resonance - steady state and dynamic response - Band width .

2. STATE SPACE DESCRIPTION 9

Introduction – Concept of State - State equation and model for systems – Time invariance and linearity – Non uniqueness of state model- State transition matrix and its properties - free and forced responses – State Diagrams -controllability and observability - kalman decomposition - Minimal Realisation - Balanced realization.

3. DESIGN IN STATE SPACE SYSTEMS 9

State feedback – output feedback – design methods – pole assignment – full order and reduced order observers – deadbeat control – deadbeat observers – introduction to optimal control.

4. NON - LINEAR SYSTEMS 9

Types of nonlinearity - typical examples - Phase plane analysis - limit cycles - equivalent linearisation -describing functions - chaotic behaviour.

Need for model reduction - aggregation techniques -dominant pole concept - model reduction via partial realization - time moment matching and Pade approximation - Hankel norm model reduction – comparative merits of various methods.

5. STABILITY 9

Stability concepts - equilibrium points - Stability in the sense of Lyapunov- BIBO and asymptotic stability - direct method of Lynapunov -application to non-linear problems - frequency domain stability criteria - Popov's method and its extensions.

L = 45 : T = 15: Total Hours=60

REFERENCES

1. M.Gopal,"Modern Control Engineering",Wiley,1996.
2. Ogatta,"Modern Control Engineering ",PHI,3rd Edition,1997.
3. G.J.Thaler,"Automatic Control systems", Jaico publishers,Chennai,1993.

YEAR	SEMESTER	TITLE OF PAPER	L	T	C
I	I	ANALYSIS OF POWER CONVERTERS	3	0	3
AIM & OBJECTIVE	To analyze the structure and functioning of power converter circuits under Power Electronics.				
OBJECTIVE	To Study About switching circuits To study the types and functions of converters from AC to DC To study the principle of operation and types of Chopper To understand the concept of AC Phase converter and its types, applications To study AC - AC converter and methods				

1. ANALYSIS OF SWITCHED CIRCUITS **5**

Ideal models and static characteristics of power switches, load circuit with electromotive force, heat sink calculations – Surge currents – limitation on di/dt, dv/dt, classification and analysis of commutation.

2. AC TO DC CONVERTERS **15**

Single and three phase bridge rectifiers, half controlled and Fully controlled converters with RL, RLE loads and freewheeling diodes ,continuous and discontinuous modes of operation , Inverter operation, Dual Converter, 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

3. DC TO DC CONVERTERS **12**

Principle of operation- step-down and step-up converters- classification- Voltage and current commutated choppers- Analysis of buck, boost, buck-boost and Cuk converters – time ratio and current limit control - Effect of source inductance, Filter circuits, multiphase chopper, resonant converters.

4. AC PHASE CONVERTER **5**

Principle of phase control, single and three phase bi-directional controllers with R, L and R-L loads, different configurations, Analysis with pure R and L loads.

5. AC TO AC CONVERTERS **8**

Principle of operation, single phase and three phase cyclo converters, gating signals-harmonics power factor control, forced commutated AC to AC converters.

Total Hours=45

TEXT BOOKS

1. Rashid M.H., " Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Second Edition, New Delhi, 1995.
2. P.C Sen.," Modern Power Electronics ", Wheeler publishing Co, First Edition,New Delhi-1998.

REFERENCE

1. Mohan N., Undeland and Robbins, " Power Electronics-Converters ", Applications and Design ", John Wiley and sons, Inc., New York, 1995

YEAR	SEMESTER	TITLE OF PAPER	L	T	C
I	I	ANALYSIS OF INVERTERS	3	0	3
AIM	To analyze the structure and functioning of inverter circuits with types and application under Power Electronics area.				
OBJECTIVE	To Study the basic concept of inverter topology To study the types of thyristor To study about current source inverter To study about multilevel inverter To study recent types of converter				

1. INVERTER-GENERIC TOPOLOGY 7

Introduction ,Principle of operation of half and full bridge inverters, General topology of single phase and three phase voltage source and Current source inverters, Need for feedback diodes in anti-parallel with Switches, Performance parameters, various harmonic elimination techniques.

2. SCR BASED CLASSICAL INVERTER 10

Series Inverters: Basic Series Inverter, Modified Series Inverter, High frequency Series inverter, Three phase Series Inverter-Design examples, Parallel Inverter, Forced commutated bridge Inverter: McMurray Inverter, McMurray Bedford Inverter.

3. SCR BASED CURRENT SOURCE INVERTERS 10

Current Source bridge inverter, Analysis of single phase and three-phase auto sequential commutated current Source inverter, current pulsations, comparison of current source inverter and voltage source inverters.

4. MULTILEVEL INVERTERS 8

Multilevel concept, diode clamped, flying capacitor, cascade type multilevel inverter,Comparison of multilevel inverters, application of multilevel inverters

5. MODERN INVERTERS 10

BJT/IGBT based modem high switching frequency Inverters, Need for Output voltage control & Harmonic elimination, PWM Inverters: different methodologies, Resonant Inverter: resonant DC link inverter, series and parallel resonant converters, Class E resonant inverter, ZCS & ZVS concepts, Principle of SMPS and UPS.

Total Hours = 45

TEXT BOOK

1. G.K. Dubey et al, " Thyristorised Power Controllers ", New Age International Pvt. Ltd., New Delhi, 1996.

REFERENCES

1. M. Ramamoorthy, " Introduction to thyristors & and their application " East-west Press, 1977.
2. Ned Mohan,Undeland and Robbin,"Power Electronics:converters,Application and design"John Wiley and sons.Inc,Newyork,1995.

YEAR	SEMESTER	TITLE OF PAPER	L	T	C
I	I	COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES	3	1	4
AIM	To impart knowledge of formulation and solution of design problems using mathematical and computational techniques apply to electrical machines				
OBJECTIVE	To understand the field concept and its problems To study the finite element & finite differential methods. To study the various concepts of CAD system and its properties To understand the concept of AC Machine designs.				

1. INTRODUCTION 5

Conventional design procedures – Limitations – Need for field analysis based design.

2. MATHEMATICAL FORMULATION OF FIELD PROBLEMS 10

Development of torque/force – Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector /Scalar potential – Stored energy in field problems – Inductance-Laplace and Poisson's Equations – Energy functional - Principle of energy conversion.

3. PHILOSOPHY OF FEM 10

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

4. CAD PACKAGES 10

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

5. DESIGN APPLICATIONS 10

Design of Solenoid Actuator – Induction Motor – Switched Reluctance Motor – Synchronous Machines.

L = 45 : T = 15: Total Hours=60

REFERENCE

1. Silvester and Ferrari,"Finite for Electrical Engineers" Cambridge University press, 1983.
2. S.R.H.Hoole, Computer – Aided, Analysis and Design of Electromagnetic Devices, Elsevier, New York, Amsterdam, London, 1989.
3. D.A.Lowther and P.P Silvester, Computer Aided Design in Magnetics, Springer verlag, New York, 1956.
4. S.J Salon,"Finite Element Analysis of Electrical Machines."Kluwer Academic Publishers, London, 1995.
5. C.W.Throwbridge,"An Introduction to computer Aided Electromagnetic Analysis", vector field ltd.
6. User Manuals of MAGNET, MAXWELL & ANSYS.Software.

YEAR	SEMESTER	TITLE OF PAPER	L	P	C
I	I	POWER ELECTRONICS SIMULATION I LAB	0	3	2
AIM	To provide hands on experience on the equipment for converters, inverters, choppers and simulation of closed loop control for electrical drives				
OBJECTIVE	To design and solve the problems of single phase , three phase half & full controlled rectifier. To run the simulation models of inverter and voltage controller				

1. Simulation of single phase half and fully controlled converter.
a) R load.
b) RL load.
c) RLE (Motor) load

2. Simulation of three phase half and fully controlled converter.
a) R load.
b) RL load.
c) RLE (Motor) load

3. Simulation of single phase half bridge Inverter

4. Simulation of three phase full bridge inverter.
a) 180 degree mode operation
b) 120 degree mode operation

5. Simulation of single phase AC voltage controller.
a) Lamp load
b) Motor load

6. Simulation of Three phase AC voltage controller.
a) Lamp load
b) Motor load

7. Simulation of cycloconverter.

Total Hours = 45

YEAR	SEMESTER	TITLE OF PAPER	L	T	C
I	II	DIGITAL SIGNAL PROCESSING	3	1	4
AIM	To equip the students with knowledge of digital signal processing and its application in power electronics engineering.				
OBJECTIVE	This subject will introduce the basic concepts and techniques for processing signals on a computer. By the end of the course, you be familiar with the most important methods in DSP, including digital filter design, transform-domain processing and importance of Signal Processors. The course emphasizes intuitive understanding and practical implementations of the theoretical concepts				

1. REVIEW OF DISCRETE TIME SYSTEMS 10

Discrete time Signals-Sequences-Stability and Causality-Frequency domain Representation of Discrete time systems and signals-Two-dimensional Sequences and Systems-Z-Transform-Z-Transform Theorems and Properties-Two-dimensional Z-Transform. Structures for discrete time system-direct, cascade and parallel forms- lattice structure.

2. THE DISCRETE FOURIER TRANSFORM 10

Representation of Periodic Sequences-the Discrete Fourier Series-Properties of the discrete Fourier series - sampling- Z-transform-discrete Fourier transform-properties of discrete Fourier Transform-Linear Convolution-Decimation-in-Time and Decimation-in-Frequency-FFT Algorithms.-Two-dimensional discrete Fourier Transform-spectral analysis-time, frequency analysis of signals.

3. DIGITAL FILTER DESIGN TECHNIQUES 16

Introduction-Design of IIR Digital Filters from Analog Filters-Analog-Digital Transformation-Properties of FIR Digital Filters-Design of FIR Filters Using Windows-A comparison of IIR and FIR Digital Filters.

4. EFFECTS OF FINITE REGISTER LENGTH IN DIGITAL SIGNAL PROCESSING 9

Introduction-Effects of coefficient of Quantization-Quantization in Sampling Analog Signals-Finite Register Length effects in realizations of Digital Filters, discrete Fourier Transform Computations.

5. APPLICATION OF DSP 9

Design of Decimation and Interpolation Filter, FFT Algorithm, PID Controller, Application for Serial Interfacing, DSP based Power Meter, Position control

L = 45 : T = 15: Total Hours=60

REFERENCES

1. Alan Oppenheim. V and Ronals W. Schafer, " Digital Signal Processing ", Prentice Hall of India Pvt.Ltd., New Delhi, 1989.
2. John-H Karl, " An Introduction to digital processing ", Academic Press INC, Harcourt Brace Jovanovich, Publishers, 1989.
3. Douglas F. Elliot, " Handbook of Digital Signal Processing - Engineering Applications ". Academic Press, 1987. King, Robert.
4. King, Robert, " Digital filtering in one and two dimensions " , Design and applications - Plenum Press 1989.
5. V.Oppenheim and Ronald W. Schafer, " Discrete time signal processing ", Prentice Hall of India Pvt.Ltd., New Delhi, 1992.
6. M.Bellanger, " Digital Processing of Signals " , John Wiley and Sons, 2000.
7. Ralph Chasseing " Digital Signal Processing Laboratory Experiments using C & TMS320 C31", John Wiley and Sons, 1999.

YEAR	SEMESTER	TITLE OF PAPER	L	T	C
I	II	SOLID STATE DC DRIVES	3	1	4
AIM	To study the principle of operation of modern control of DC drives with relevant field applications over all the power electronics area.				
OBJECTIVE	To understand the basic concept of DC Drives. To understand the various control techniques involved with DC Drives. To brief about the working principle of Special Electrical Drives. Design and Analyze different control techniques of DC Drive				

1. REVIEW OF CONVENTIONAL DC DRIVES 9

Different techniques of speed control and methods of braking of series and Methods of braking of series and separately excited DC motor. Ward-Leonard Speed control, Inching and jogging, Models and transfer function of series and Separately excited DC motor.

2. CONVERTER CONTROL OF DC MOTORS 9

Analysis of series and separately excited DC motor with single phase and Three phase converters operating in different modes and configurations, Problems on DC machines fed by converter supplies CLC and TRC strategies.

3. CHOPPER CONTROL OF DC MOTORS 9

Analysis of series and separately excited DC motors fed from different Choppers, effect of saturation in series motors CLC and TRC strategies.

4. DESIGN OF CONVERTER FED DC DRIVES 9

Speed loop, current loop, armature current reversal, field current reversal: Inching, Digital controller and firing circuits, simulation.

5. INTELLIGENT CONTROLLER FOR DC DRIVE 9

Microcomputer implementation of control function, Fuzzy, Neuro, Fuzzy neuro controllers.

L = 45 : T = 15: Total Hours=60

TEXT BOOK

1. Buxbaum, A.Schierau, K.and Staughen, "A Design of control System for d.c Drives ", Springer-Verlag, berlin, 1990.
2. Dubey, G.K. "Power Semiconductor Controlled Drives ", Prentice Hall I international, New Jersey, 1989.

REFERENCES

1. Sen, P.C. "Thyristor D.C Drives ", John Wiley & Sons, New York, 1981.
2. Subharamanyam V. "Electric Drives -Concepts and Applications ", Tata McGraw Hill Publishing Co., Ltd, New Delhi, 1994.
3. B.K Bose, Expert System, fuzzy logic and logic and neural network applications in power electronics and motion control, proceedings of IEEE, special issue on Power Electronics and motion control, August 1994, PP.1303.
4. T.Thyagarajan, Investigations on intelligent control strategies for air heating systems, Ph.d Thesis, Anna University, Nov.1999.
5. V.Senthil Kumar, Investigation on intelligent control strategies for permanent magnet, brushless dc Drive, M.E Thesis, Division of Power Electronic and drive, Anna University, Dec' 2000.

YEAR	SEMESTER	TITLE OF PAPER	L	T	C
I	II	SOLID STATE AC DRIVES	3	1	4
AIM	To study the principle of operation of modern control of AC drives with various field applications over all the power electronics area.				
OBJECTIVE	To understand the basic concept of AC Drives. To understand the various control techniques involved with AC Drives. To brief the working principle of Special Electrical Drives. Design and Analyze different control techniques of AC Drive				

1. STATOR VOLTAGE CONTROL OF INDUCTION MOTOR 8

Torque, slip characteristics, Operation with different types of loads, performance, comparison of different ac power controllers, Speed reversal, Closed loop control.

2. STATOR FREQUENCY CONTROL 12

Operation of induction motor with non-sinusoidal supply waveforms, Variable frequency operation of 3-phase induction motors, Constant flux operation, Current fed operations, Dynamic and regenerative braking of CSI and VSI fed drives, Principle of vector control.

3. ROTOR RESISTANCE CONTROL 8

Torque, Slip characteristics, Types of rotor choppers, Torque Equations, Constant torque operations, TRC Strategy, Combined stator voltage control and rotor resistance control.

4. SLIP POWER RECOVERY SCHEME 8

Torque equation, Torque-slip characteristics-power factor considerations, Sub-synchronous operation and closed loop control.

5. SYNCHRONOUS MOTOR DRIVES 9

Need for leading pf operation-open loop VSI fed drive and its characteristics-Self control-torque angle control-Power factor control Brushless excitation systems-Starting methods-Principles of Vector control.

L = 45 : T = 15: Total Hours=60

TEXT BOOKS

1. Murphy, J.M.D, Turnbull, F.G. " Thyristor control of AC motors ", Pergamon Press, Oxford, 1988.
2. Sheperd, W. and Hully, L.N. " Power Electronics and motor control ", Cambridge University Press, Cambridge, 1987.

REFERENCES

1. Dubey, G.K. " Power Semiconductor controlled drives ", Prentice Hall, International New Jersy, 1989.
2. Dewan, S.B Slemon, G.R. Straughen, A. " Power semiconductor drives ", John Wiley and Sons, New York, 1984.

YEAR	SEMESTER	TITLE OF PAPER	L	T	C
I	II	MICRO-CONTROLLER BASED SYSTEM DESIGN	3	0	3
AIM	To study the principle of operation of micro controller based system design				
OBJECTIVE	To teach students design and interfacing of microcontroller-based embedded systems. To understand High-level languages are used to interface the microcontrollers to various applications. There are extensive hands-on labs/projects. Embedded system for sensor applications will be introduced. GUI using C# will be introduced. To develop independence and learn much of the material on their own To understand the architecture of the PIC microcontrollers and how to write high-level languages, and embed the code in flash memory for stand-alone system for embedded system designs.				

1. PROGRAMMING FRAME WORK 9

8096 CPU Structure-Register file-Assembly language -Addressing mode-Instruction set- simple programs.

2. REAL TIME CONTROL 9

8086 interrupt structure-interrupt control priorities-critical Region-Programmable timers-interrupt density and interval constraints-Real time clock.

3. INPUT/OUTPUT PORTS 9

High Speed inputs: Modes , interrupt and status-High Speed outputs: HSO CAM-Software timers-input ports - output ports-I/O control and status registers.

4. 8096 EXPANSION METHODS 9

Bus control-Memory timing-external RAM and ROM expansion-PWM control-A/D interface - serial port.

5. SOFTWARE BLOCKS AND APPLICATION 9

Queues, Tables and Strings-State machine-key switch parsing-application of 8096 controller to generate gating signal for converter and inverters.

Total Hours=45

TEXT BOOK

1. John B. Peatman, " Design with micro - controllers ", Mc-Graw Hill International Ltd, Singapore, 1989.

REFERENCES

1. Intel manual on 16 bit embedded controllers, Santa Clara, 1991.
2. Michael Slater, " Microprocessor based design ", A Comprehensive guide to effective hardware design, Prentice Hall, New Jersey, 1989.

YEAR	SEMESTER	TITLE OF PAPER	L	P	C
I	II	POWER ELECTRONICS SIMULATION II LAB	0	3	2
AIM	To provide hands on experience on the equipment for converters, inverters, choppers and simulation of closed loop control for electrical drives				
OBJECTIVE	To design and solve the problems of single phase, three phase half & full controlled rectifier. To run the simulation models of inverter and voltage controller To simulate voltage and current commutated chopper To run the simulation of AC voltage controller To design and simulate cycloconverter				

LIST OF EXPERIMENTS

1. Microprocessor based firing scheme for three–phase converter.
2. Speed control of DC Shunt motor.
3. Speed control of PWM inverter fed three–phase induction motor.
4. Voltage commutated chopper.
5. Current commutated chopper.
6. Mc Murray – Bedford inverter.
7. AC voltage controller.
8. Series inverter.
9. Cycloconverter.

Total Hours = 45

YEAR	SEMESTER	TITLE OF PAPER	L	P	C
II	**III**	**PROJECT WORK PHASE - I**	**0**	**12**	**6**
OBJECTIVE	To impart the practical knowledge to the students and also to make them to carry out the technical procedures in their project work. To provide an exposure to the students to refer, read and review the research articles, journals and conference proceedings relevant to their project work and placing this as their beginning stage for their final presentation				
METHODOLOGY	➢ Three reviews have to be conducted by the committee of minimum of three members one of which should be the guide ➢ Problem should be selected ➢ Students have to collect about 20 papers related to their work ➢ Report has to be prepared by the students as per the format ➢ Preliminary implementation can be done if possible ➢ Internal evaluation has to be done for 200 marks				

YEAR	SEMESTER	TITLE OF PAPER	L	P	C
II	**IV**	**PROJECT WORK PHASE - II**	**0**	**24**	**12**
OBJECTIVE	This enables and strengthens the students to carry out the project on their own and to implement their innovative ideas to forefront the risk issues and to retrieve the hazards by adopting suitable assessment methodologies and stating it to global.				
METHODOLOGY	➢ Three reviews have to be conducted by the committee of minimum of three ➢ members one of which should be the guide ➢ Each review has to be evaluated for 400 marks. ➢ Attendance is compulsory for all reviews. If a student fails to attend review for Some valid reason, one or more chance may be given. ➢ They should publish the paper preferably in the journals/conferences. ➢ Final review will be done by the committee that consists of minimum of three ➢ members one of which should be the guide (if possible include one external expert Examiner within the college). ➢ The report should be submitted by the students around at the end of May.				

ELECTIVE PAPERS

ELECTIVE	TITLE OF PAPER	L	P	C
	MICROPROCESSOR APPLICATION IN POWER ELECTRONICS	3	0	3

AIM	To study about microprocessor applications in different power electronics drives and its types of controlling schemes.
OBJECTIVE	To understand the architecture of microprocessor and its interfacing devices To understand the concept of firing schemes, and different types of PWM techniques. To explore closed loop control schemes To comprehend the application of microprocessor of various power electronics and drives.

1.REVIEW OF MICROPROCESSORS **9**

Introduction – Microprocessor, Architecture and Programming of 8085 and 8086, A/D and D/A converters. Interfacing of 8253, 8255, 8155 and other important interfacing ICs.

2. MICROPROCESSOR BASED FIRING SCHEME FOR CONVERTERS **10**

Importance of firing schemes in the converter, Firing schemes for single and three phase rectifiers,3-phase AC choppers, Firing at variable frequency environments, Firing scheme for DC choppers, voltage and current communication, Inverters, types of pulse width modulation techniques and their implementation.

3.MICROPROCESSORS IN CLOSED LOOP CONTROL SCHEMES **10**

Introduction – Open and Closed loop systems , Importance of measurement and sensing in closed loop control, Measurement of voltage, current, speed, power and power factor using microprocessors, Implementation of various types of controllers using microprocessors.

4. **MICROPROCESSORS IN SPECIAL APPLICATIONS OF POWER ELECTRONICS 6**

Static excitation of synchronous generators, Solid State tap-changers for transformers, UPS systems, Induction furnace control.

5. MICROPROCESSOR APPLICATION IN ELECTRIC DRIVES **10**

Introduction of Electric drives, Importance of Microprocessor firing schems in the electric drives Firing schemes to control of DC drive, induction motors, synchronous motors and other special machines, Application in Electrical Traction.

Total Hours = 45

REFERENCES

1. Gaonkar, R.S., " Microprocessor Architecture ", Programming and Application with 8080/8085 " Wiley Eastern Limited, New Delhi, 1991.
2. Hall, D.V. " Microprocessors and Interfacing ", McGraw-Hill Publishing Company, New Delhi,1986.
3. Lecture notes on " Microprocessor in power Electronics ", Prepared by Power Electronics division, SEEE, College of Engineering, Chennai.

ELECTIVE	TITLE OF PAPER	L	P	C
	SPECIAL MACHINES AND CONTROLLERS	3	0	3

AIM	To learn about special machines in drives and different types of controller
OBJECTIVE	To understand the principal, construction and operation of VRS motor and its characteristics in different case. To understand the basics of switched reluctance motoring principle of operation and its controller function with characteristics. To explore synchronous reluctance motor To comprehend the brushless DC motor and drives with characteristics. To understand the basics of permanent magnst synchronous motor and its controller

1. STEPPING MOTORS 10

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

2. SWITCHED RELUCTANCE MOTORS 10

Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control Microprocessors based controller.

3. SYNCHRONOUS RELUCTANCE MOTORS 9

Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – phasor diagram, motor characteristics – Linear induction machines.

4. PERMANENT MAGNET BRUSHLESS DC MOTORS 15

Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessors based controller.

5. PERMANENT MAGNET SYNCHRONOUS MOTORS 10

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes.

Total Hours = 45

TEXT BOOKS :

1. Miller, T.J.E. " Brushless permanent magnet and reluctance motor drives ", Clarendon Press, Oxford, 1989.
2. Kenjo, T and Naganori, S " Permanent Magnet and brushless DC motors ", Clarendon Press, Oxford, 1989.
3. Kenjo, T, " Stepping motors and their microprocessor control ", Clarendon Press, Oxford, 1989.
4. B.K. Bose, “Modern Power Electronics & AC drives”

ELECTIVE	TITLE OF PAPER	L	P	C
	ADVANCED SEMICONDUCTOR DEVICES AND THEIR APPLICATIONS	3	0	3

AIM	To provide an insight into the principles and operation of semiconductor devices, recent devices and its uses in power electronics
OBJECTIVE	To discuss about different types of semi conductor switches To study about the power devices of diode BJT. To study the operation and types of thyristors and GTO and its characteristics To understand the concept of IGBT and power MOSFETs. To discuss about applications of power switches.

1. OVERVIEW OF POWER SEMICONDUCTOR SWITCHES 9

Introduction, Diodes, thyristors, BJTs, MOSFETs, GTOs IGBTs, Comparison of these as switching devices, Drive and Protection circuit for these devices.

2. POWER DIODES AND BJTs 9

Basic V-I characteristics of power diodes, Schottky diode, Snubber design-Switching characteristics of BJTs, Design of drive circuits for BJTs, safe operating area.

3. THYRISTORS AND GTOs 9

V-I characteristics of thyristors and GTOs, physics of device operation, Switching characteristics, Thermal characteristics, Gating characteristics and protection.

4. IGBTs AND POWER MOSFETs 9

Basic structure, V-I characteristics, Device operation, switching characteristics , Drive circuits and protection.

5. APPLICATIONS 9

Single phase rectifiers and three phase rectifiers, choppers, Inverters using GTOs-IGBTs and power MOSFETs-application of power diodes.

Total Hours=45

TEXT BOOK

1. Mohan, Net al. " Power Electronics: Converters, Application and Design ", John Wiley and Sons, Newyork, 1995.

REFERENCES

1. Kassakian, J.G. et al. " Principles of Power Electronics ", Addision Wesley Publishing Co., 1991.
2. Murphy, J.M.D. and Turnbull, F.G " Power Electronics Control of AC Motors ", Pergamon Press, Oxford, 1988.
3. Rashid M.H., " Power Electronics Circuits, Devices and Applications ", PrenticeHall India, New Delhi, 1995.

ELECTIVE	TITLE OF PAPER	L	P	C
	FLEXIBLE AC TRANSMISSION SYSTEMS	3	0	3

AIM	To enhance the transmission capability of transmission system by shunt and series compensation using static controllers.
OBJECTIVE	To understand the concept of flexible AC transmission and the associated problems. To review the static devices for series and shunt control. To study the operation of controllers for enhancing the transmission capability.

1. INTRODUCTION 9

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

2. SERIES COMPENSATION SCHEMES 9

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

3. UNIFIED POWER FLOW CONTROL 9

Introduction, Implementation of power flow control using conventional thyristors, Unified power flow concept, Implementation of unified power flow controller.

4. DESIGN OF FACTS CONTROLLERS 9

Approximate multi-model decomposition, Variable structure FACTS controllers for Power system transient stability, Non-linear variable-structure control, variable structure series capacitor control, variable structure resistor control.

5. STATIC VAR COMPENSATION 9

Basic concepts, Thyristor controlled reactor (TCR), Thyristors switched reactor(TSR), Thyristor switched capacitor(TSC), satured reactor (SR) , and fixed capacitor (FC)

Total Hours = 45

REFERENCES

1. Narin G.Hingorani, " Flexible AC Transmission ", IEEE Spectrum, April 1993, pp 40-45.
2. Narin G. Hingorani, " High Power Electronics and Flexible AC Transmission Systems ", IEEE Power Engineering Review, 1998.
3. Narin G.Hingorani, " Power Electronics in Electric Utilities : Role of Power Electronics in future power systems ", Proc. of IEEE, Vol.76, no.4, April 1988.
4. Einar V.Larsen, Juan J. Sanchez-Gasca, Joe H.Chow, " Concepts for design of FACTS Controllers to damp power swings ", IEEE Trans On Power Systems, Vol.10, No.2, May 1995.
5. Gyugyi L., " Unified power flow control concept for flexible AC transmission ", IEEE Proc-C Vol.139, No.4, July 1992.

ELECTIVE	TITLE OF PAPER	L	P	C
	COMPUTER NETWORK ENGINEERING	3	0	3

AIM	To provide an overview of theory and architecture of computer communication networks
OBJECTIVE	To understand the concept of protocols and architectures. To review the network access protocol and transport protocol, rooting techniques. To study the network management.

1. PROTOCOLS AND ARCHITECTURES 10

Protocols-layered approach-OSI model-DoD model-Hierarchical Approach-Local Network Technology- Bus/Tree topology-Ring topology-medium access protocols -Details of IEEE 802 standards.

2. NETWORK ACCESS PROTOCOL & INTERNETWORKING 9

Circuit Switched Network Access-Packet Switched Network Access-Broadcast Network Access-Principle of Internetworking-Bridges, Gateways-X, 75-internet protocols-ISO Internet protocol standard.

3. TRANSPORT PROTOCOL & ROUTING TECHNIQUES 9

Transport Service protocol Mechanisms-Network Service-Transport standards-Internet Transport protocols-Wireless UDP-Overview of routing techniques.

4. PRESENTATION/APPLICATION PROTOCOLS 9

File Transfer Protocols-World Wide Web-Electronic Mail-Overview of ISDN-ISDN Protocols.

5. NETWORK MANAGEMENT 8

Architecture of network management-Fault management-Congestion Control Algorithms-Security Management.

Total Hours=45

TEXT BOOKS

1. Stallings, " Data and Computer Communication ", Maxwell and Macmillan, 1988.
2. Andrew Tannenbaum S., " Computer Networks ", 3rd Edition, Prentice Hall of India, 1997.

REFERENCES

1. " Stallings, Data and Computer Communication: Architectures, Protocols and Standards, Protocols and Standards ", IEEE, Computer Society, 1987.
2. Kernel Texpian A.S., " Communication Network Management ", Prentice Hall, 1992.
3. " Network Management ", Standards, Uylers Black, McGraw Hill, 1995.
4. Commer and Stevens, " Internetworking with TCP/IP Vol.III: Client Server Programming and application ", Prentice Hall , USA, 1994.

ELECTIVE	TITLE OF PAPER	L	P	C
	SOFTWARE FOR ELECTROMAGNETIC DESIGN	3	0	3

AIM	To enhance the electromagnetic concepts in modeling. And analyze electromagnetic system by different methods.
OBJECTIVE	To understand the concept of FEA and CAD packages and modeling. To review 2D modeling, Actuator, and analyze SR motor To study about harmonic field and 3D analyze of claw. To review the interfacing circuit simulations, parametric analysis To understand different types of electro mechanical system.

1. INTRODUCTION **10**

Review of EM theory – FEA formulation – Organisation of CAD packages – Finite element analysis – 2D Modelling – Translational and rotational symmetry – Boundary conditions – Material property modeling.

2. ANSYS **10**

2D modeling – Element types – Mesh refinement – setting up problem – Post processing – case studies – Analysis of solenoid actuator – Thermal analysis of fuse element – model analysis of SR motor – 3D analysis of claw – Pole Alternator.

3. MAGNET **10**

2D Modelling – Meshing – Material characteristics – Boundary conditions – problem editing – Solution – Post processing – case studies - Analysis of SR motor – Induction motor – Interfacing with circuit simulation packages – Static and Harmonic fields.

4. MAXWELL **8**

2D modeling – Grouping objects – Material characteristics – Boundary conditions – Problem editing – Solution – Mesh refinement - Post processing – Parametric analysis

5. **ELECTRO MECHANICAL SYSTEMS** 7

Electromechanical System Simulation (EMSS) – Analysis of solenoid actuator – Switched Reluctance motor – 3D analysis of Claw – Pole Alternator.

Total Hours=45

REFERENCES :

1. Ansys user Manual.
2. Magnet user Manual , Infolytica Corporation.
3. Maxwell user Manual , Ansoft Corporation.

ELECTIVE	TITLE OF PAPER	L	P	C
	SOFTWARE FOR CIRCUIT SIMULATION	3	0	3

AIM	To study the advanced techniques in simulation softwares.
OBJECTIVE	To understand the importance of simulation and modelings. To review PSPICE simulation techniques, and its devices. To study about saber command scripts and its domain analysis.

1. INTRODUCTION **10**

Importance of simulation, General purpose of circuit analysis, Methods of analysis of power electronics systems, Review of modeling of power electronic components and systems, programs

2. ADVANCED TECHNIQUES IN SIMULATION **10**

Analysis of power electronic systems in a sequential manner coupled and decoupled systems – Various algorithms for computing steady state solution in power electronic systems – Future trends in computer simulation.

3. PSPICE **10**

Introduction – Pspice overview – DC circuit Analysis – AC circuit analysis – Transients and the time domain – Fourier series and Harmonic components – An introduction to Pspice devices BJT, FET, MOSFET and its model – Amplifiers and Oscillators – Non linear devices.

4. SABER **15**

Introduction – Analogy libraries – DC Frequency domain Analysis – Schematic Capture and libraries – Time domain analysis – System level integration and analysis – DC transfer analysis – Monte carto analysis – AIM and saber command Scripts – Sensitivity/Stress analysis – Fourier analysis – Mixed signal analysis – Cross – probing – Saber designer Documentation.

Total Hours=45

REFERENCES

1. Rajagopalan,V.Computer aided analysis of power electronic systems'-Marcell – Dekker Inc.,1987.
2. John Keown "Microsim Pspice and circuit analysis" – Prentice hall Inc.,1998.
3. Orcad Pspice user manual ,Orcad corporation.
4. Saber user manual, Analogy corporation.

ELECTIVE	TITLE OF PAPER	L	P	C
	SOFTWARE FOR CONTROL SYSTEMS DESIGN	3	0	3

AIM	To enhance the software techniques for control system and its design.
OBJECTIVE	To understand the concept of control system design. To review MATLAB tools, programs, and controller design To study about simulink techniques. To review the MAPLE and its numerical programming

1. INTRODUCTION **10**

Review of solution of differential equations – Optimation techniques – Controller design – Software packages for control system design.

2. MATLAB **10**

Introduction – function description – Data types – Tool boxes – Graphical Displays - Import and Export of data – Programs for solution of state equations – Controller design – Limitations.

3. SIMULINK **10**

Introduction – Graphical user interface – Starting – Selection of objects – Blocks – Lines - simulation – Application programs – Limitations.

4. MAPLE **15**

Introduction – symbolic programming – Programming constructs – Data structure computation with formulae – Procedures – Numerical Programming.

Total Hours=45

REFERENCES

1. MAPLE V Programming guide.
2. MATLAB user manual.
3. SIMULINK user manual.
4. MATHCAD user guide.
5. K.Ogatta ,"Modern Control Engineering",PHI,1997.
6. Dorf and Bishop,"Modern control Engineering',Addison Wesley,1998.

ELECTIVE	TITLE OF PAPER	L	P	C
	DIGITAL INSTRUMENTATION	3	0	3

AIM	To learn the concept of digital principles, digital Instrumentation setup to measure various parameters and the recent trends in digital instrumentation.
OBJECTIVE	➢ To review the basics of digital electronics ➢ To learn the various digital methods of measurement ➢ To discuss the digital display and recording devices ➢ To understand the concept of digital signal analysis ➢ To discuss the current trends in digital instrumentation

1. INTRODUCTION **8**

Digital codes – memory devices – basic building blocks – gates, FF and counters – discrete data handling – sampling – sampling theorem – aliasing errors – reconstruction – extrapolation – synchronous and asynchronous sampling.

2. DIGITAL METHODS OF MEASUREMENTS **15**

Review of A/D, D/A techniques – F/V and V/F conversion techniques – digital voltmeters and multi meters – automation and accuracy of digital voltmeters and multi meters – digital phase meters – digital techno meters – digital frequency, period and time measurements – low frequency measurements – automatic time and frequency scaling –sources of error- noise-inherent errors in digital meters, Hidden errors in conventional ac measurements – RMS detector in digital multi meters – mathematical aspects of RMS.

3. DIGITAL DISPLAY & RECORDING DEVICES **8**

Digital storage oscilloscopes – digital printers and plotters – CDROMS – digital magnetic tapes, dot matrix and LCD display CROs, Colour Monitor, Digital Signal Analyser, and Digital Data Acquisition.

3. SIGNAL ANALYSIS **6**

Amplifiers, filters, transmitter, receiver, wireless base and mobile station test sets, noise figure meters, RF network analyzer, and high frequency signals sources.

5.CURRENT TRENDS IN DIGITAL INSTRUMENTATION **8**

Introduction to special function add on cards – resistance card – input and output cards counter, test, and time of card and Digital Equipment construction with modular designing; interface to microprocessor, micro- controllers and computers. Computer aided software engineering tools (CASE) – use of CASE tools in design and development of automated measuring systems – interfacing IEEE cards – intelligent and programmable instruments using computers.

Total Hours=45

REFERENCES

1. Bouwens ,A.J.”Digital instrumentation.” McGraw Hill,1984.
2. John Lenk,D.”Handbook of Microcomputer based instrumentation and control”,PH ,1984.
3. Doebelin ,Measurement system ,Application and Design,IV Ed,McGraw Hill,1990.
4. Product catalogue ,Hewlet Packard,1996

ELECTIVE	TITLE OF PAPER	L	P	C
	THEORY AND DESIGN OF NEURO-FUZZY CONTROLLERS	3	0	3

AIM	To introduce students to neural networks and fuzzy theory from an engineering perspective. In the identification and control of dynamic systems, neural networks and fuzzy systems can be implemented as model-free estimators and/or controllers. As trainable dynamic systems, these intelligent control systems can learn from experience with numerical and linguistic sample data.
OBJECTIVE	➢ Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory. ➢ Explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers. ➢ Develop and implement a basic trainable neural network or a fuzzy logic system for a typical control, computing application or biomedical application.

1. NEURAL NETWORK **10**

Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules types of neural networks-single layer, multiplayer-feed forward, feedback networks; back propgationlearning and training-Hopfield network.

2. NEURAL NETWORKS IN CONTROL **10**

Neural network for non-linear systems-schemes of neuro control-system identification forward model and inverse model-indirect learning neural network control applications-case studies.

3. FUZZY LOGIC **10**

Fuzzy sets-fuzzy operation-fuzzy arithmetic-fuzzy relations-fuzzy relational equations-fuzzy measure-fuzzy functions-approximate reasoning-fuzzy propositions-fuzzy quantifiers-if-then rules.

4. NEURAL NETWORK IN CONTROL **15**

Structure of fuzzy logic controller-fuzzification models-data base-rule base-inference engine defuzzification module. Non-linear fuzzy control-PID like FLC-Sliding mode FLC - Surgeno FLC-adaptive fuzzy control-fuzzy control applications-case studies.

Total Hours=45

REFERENCES

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.
4. Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 1994.
5. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers.
6. Farin Wah S.S, Filev, D.Langari, R. "Fuzzy control synthesis and analysis", John Wiley and Sons 2000.

ELECTIVE	TITLE OF PAPER	L	P	C
	DESIGN OF INTELLIGENT CONTROLLERS	3	0	3

AIM	To provide an introduction to the design of intelligent control systems. To build upon current research and to enable students to make a contribution to practical applications.
OBJECTIVE	➢ To understand the various hierarchical architectures of intelligent control systems. ➢ To use modern computational aids for the design of control systems. ➢ To design and evaluate system performance in the time and frequency domain. ➢ To understand and design simple rule-based controllers. ➢ To understand and design fuzzy logic controllers. ➢ To understand and design artificial neural net

1. INTRODUCTION 6

Model based controllers – adaptive controllers – model reference adaptive control – model identification adaptive controllers – optimal control – predictive control.

2. ARTIFICIAL INTELLIGENT BASED SYSTEMS 9

Natural language system – perception system for vision speech and touch - expert or knowledge based system – knowledge acquisition – knowledge of representation – inference strategy – expert controller.

3. FUZZY LOGIC SYSTEM 8

Introduction- Fuzzy controller –fuzzyfier-knowledge base – defuzzyfier – fuzzy logic controller – fuzzy logic controller examples.

4. ARTIFICIAL NEURAL NETWORK **12**

Introduction – artificial network – classification based n topology and learning method – learning rules – perceptron – multi I/P and multi O/P perceptron – multi layer artificial neural network – error propagation learning algorithm – neural controllers.

5. VLSI IMPLEMENTATION OF NEURAL NETWORKS 10

Analog and digital techniques – hybrid systems – special purpose VLSI chips- neuro-fuzzy control system.

Total Hours=45

REFERENCE

1. Gupta, M.M. and Rao, D.H.,"Neuro Control Systems, Theory and Application", IEEE, Press USA 1994.
2. Hertz, John, Krogh, Anders and Palmer, Richard, G.,"Introduction to the theory of neural computation", Addision-Wesley, New York, 1991.
3. King, P.J. and Momdonni, E.H.,"The applications of fuzzy control systems to Industiral processes", 6th IFAC Congress on control technology in the service of man, 1975.
4. Nelson, Morgon, "Artifical neural networks: Electronic implementation", IEEE Computer Society Press, USA, 1990.
5. Togai, M and Watanbe, H.A., "Fuzzy Inference Engine on a VLSI Chip – Design and Implementation:, 2nd Fuzzy System Symposium, 1986.

ELECTIVE	TITLE OF PAPER	L	P	C
	OBJECT ORIENTED PROGRAMMING AND ITS APPLICATIONS TO ELECTRICAL ENGINEERING	3	0	3

AIM	To provide an introduction practical applications of Object oriented programming and its features..
OBJECTIVE	➢ To learn the fundamentals of object-oriented design and implementation in C++. ➢ The objectives of the course are to have students identify and practice the object-oriented programming concepts and techniques, practice the use of C++ classes and class libraries, modify existing C++ classes, develop C++ classes for simple applications, and practice the concepts of Object-Oriented Analysis and Design (OOA/OOD) and design patterns and frameworks by developing a C++ based project.

1. OBJECT ORIENTED PROGRAMMING PARADIGM 5

Introduction - reusability - security - object oriented programming fundamentals - abstraction - encapsulation - derivation - object oriented languages and packages.

2. CLASSES AND OBJECTS 15

Introduction to C++ - procedural oriented approach to C++ - data types - control structures - problem solving - standard input and output streams - C++ enhancements - function prototypes - default reference variables - constants - classes - constructors - destructors - constraint objects - member objects and the functions.

3. ADVANCED FEATURES 10

Dynamic memory allocation pointers - new and delete operators - classes with pointers - copy constructor - static member - friend classes - friend functions - operator overloading.

4. POLYMORPHISM AND INHERITANCE 10

Function overloading - connection classes - derived classes - class conversion -protected members – virtual functions - dynamic binding - abstract classes - multiple inheritance - templates - error handling.

5. CASE STUDIES 5

Overview of typical object oriented systems - case studies - application to electrical engineering.

Total Hours=45

REFERENCES

1. Stanley B. Lipman, " C++ primer ", Addison Wesley, 1989.
2. Bertrand Meyar, " Object software construction ", Prentice Hall, 1988.
3. K.R. Dittrich et al, " On object oriented data base system ", Springer verlag, 1991.

ELECTIVE	TITLE OF PAPER	L	P	C
	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	3	0	3

AIM	To develop the skills in the area of HVDC power transmission with the analysis of HVDC converters, harmonics and design of filters.
OBJECTIVE	➢ To impart knowledge on design, simulation and analysis of HVDC converters and associated control system. ➢ To study the general aspects of HVDC system, Power Electric Circuits used in HVDC system, protection of HVDC system against faults Harmonics in HVDC as their reduction, and the simulation of HVDC system. ➢ To understand the concept, planning of DC power transmission and comparison with AC power transmission. ➢ To analyze HVDC converters. ➢ To analyze harmonics and design of filters. ➢ To learn about HVDC cables and simulation tools

1. 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.

2. ANALYSIS OF HVDC CONVERTERS 9

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

3. CONVERTER AND HVDC SYSTEM CONTROL 9

General principles of DC link control-converter control characteristics –system control hierarchy – firing angle control-current and extinction angle control-starting and stopping of DC link – power control-higher level controllers – telecommunication requirements.

4. HARMONICS AND FILTERS 9

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

5. SIMULATION OF HVDC SYSTEMS 9

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

Total Hours=45

EFERENCES

1. Padiyar, K.R., HVDC Power transmission system, Wiley Eastern Limited, New Delhi, 1990.
2. Edward Wilson Kimbark, Direct Current Transmission, Vol.1, Wiley Interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, Extra high voltage AC transmission engineering Wiley Eastern Ltd., New Delhi, 1990.
4. Arrillaga, J., High voltage direct current transmission, Peter Pregrinus, London, 1983.
5. Adamson, C.and Hingorani.N.G., High Voltage Direct Current Power Transmission, GarrawayLimited, London, 1960.
6. www.abb.se/pow/hvdc.htm
7. www.pwrgen.westinghouse.com/energy/facts.htm
8. www.hvdc.ca

	TITLE OF PAPER	L	P	C
ELECTIVE	**POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS**	**3**	**0**	**3**

AIM	To introduce students to the theory and practice of renewable energy and its integration to smart grid
OBJECTIVE	➢ To understand general physical mechanism of energy conversion ➢ To understand basic power electronics principles, like the dc – dc converter and dc – ac inverter ➢ To understand renewable energy generation, especially wind and solar energy generations. ➢ To understand the basic principles of renewable energy integration to smart grid ➢ To know how to design a renewable energy system for smart grid

1. 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.

2. ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION **9**

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

3. 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.

4. 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 and SCIG Based WECS-Grid Integrated solar system

5. 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 Hours=45

REFERENCES:

1. Rashid .M. H "power electronics Hand book", Academic press, 2001.
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
3. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.
4. Gray, L. Johnson, "Wind energy system", prentice hall linc, 1995.
5. Non-conventional Energy sources B.H.Khan Tata McGraw-hill Publishing Company, New Delhi.