

ANNA UNIVERSITY TIRUCHIRAPPALLI**Tiruchirappalli – 620 024****Regulations 2008****Curriculum****M.E. POWER ELECTRONICS AND DRIVES****SEMESTER I**

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	MA5121	Applied Mathematics for Electrical Engineers	3	1	0	4
2	PE5101	Modeling and Analysis of Electrical Machines	3	0	0	3
3	PE5102	Advanced Power Semiconductor Devices	3	0	0	3
4	PE5103	Analysis of Power Converters	3	0	0	3
5	PE5104	Analysis of Inverters	3	0	0	3
6	E1****	Elective I	3	0	0	3
Total						19

SEMESTER II

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	PE5151	Computer Aided Design of Electrical Apparatus	3	1	0	4
2	PE5152	Solid State DC Drives	3	0	0	3
3	PE5153	Solid State AC Drives	3	0	0	3
4	PE5154	Embedded Control of Electrical Drives	3	0	0	3
5	E2****	Elective II	3	0	0	3
6	E3****	Elective III	3	0	0	3
Practical						
7	PE5155	Power Electronics and Drives Laboratory	0	0	3	2
Total						21

SEMESTER III

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	E4****	Elective IV	3	0	0	3
2	E5****	Elective V	3	0	0	3
3	E6****	Elective VI	3	0	0	3
Practical						
4	PE5251	Project Work Phase I	0	0	12	6
Total						15

SEMESTER IV

S.No.	Subject Code	Subject	L	T	P	C
Practical						
1	PE5251	Project Work Phase II	0	0	24	12
Total						12

Total Credits to be Earned for the Award of the Degree = 67

LIST OF ELECTIVES

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	PE5001	Special Electrical Machines	3	0	0	3
2	PE5002	Computer Communication and Networks	3	0	0	3
3	PE5051	Software Engineering and Architecture	3	0	0	3
4	PS5002	High Voltage Direct Current Transmission	3	0	0	3
5	PS5003	Flexible AC Transmission Systems	3	0	0	3
6	PS5051	Intelligent Control	3	0	0	3
7	CI5101	Linear and Non-Linear Systems Theory	3	0	0	3
8	CI5102	Digital Signal Processing	3	0	0	3
9	CI5052	Digital Signal Processors	3	0	0	3

ANNA UNIVERSITY TIRUCHIRAPPALLI

Tiruchirappalli-620024

Regulations 2008

Syllabus

M.E. POWER ELECTRONICS AND DRIVES

SEMESTER I

MA5121 – APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

	L	T	P	C
	3	1	0	4
UNIT I ADVANCED MATRIX THEORY				9
Matrix norms - Jordan canonical form - generalized eigenvectors - singular value decomposition - Pseudo inverse - least square approximations - QR algorithm.				
UNIT II CALCULUS OF VARIATIONS				9
Variation and its properties - Euler's equation - functional dependent on first and higher order derivatives - functional 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: 60

REFERENCES

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

PE5101 – MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

UNIT I PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION 8

General expression of stored magnetic energy - co-energy and force/torque - example using single and doubly excited system.

UNIT II BASIC CONCEPTS OF ROTATING MACHINES 9

Calculation of air gap M.M.F. - per phase machine inductance using physical machine data - voltage and torque equation of D.C. machine - three phase symmetrical induction machine and salient pole synchronous machines in phase variable form.

UNIT III INTRODUCTION TO REFERENCE FRAME THEORY 11

Static and rotating reference frames - transformation relationships - examples using static symmetrical three phase R, R-L, R-L-M and R-L-C circuits - application of reference frame theory to three phase symmetrical induction and synchronous machines - dynamic direct and quadrature axis model in arbitrarily rotating reference frames - voltage and torque equations - derivation of steady state phasor relationship from dynamic model - generalized theory of rotating electrical machine and Kron's primitive machine.

UNIT IV DETERMINATION OF SYNCHRONOUS MACHINE DYNAMIC EQUIVALENT CIRCUIT PARAMETERS 8

Standard and derived machine time constants - frequency response test - analysis and dynamic modeling of two phase asymmetrical induction machine and single phase induction machine.

UNIT V SPECIAL MACHINES 9

Permanent magnet synchronous machine - surface permanent magnet (square and sinusoidal back E.M.F. type) and interior permanent magnet machines - construction and operating principle - dynamic modeling and self controlled operation - analysis of switch reluctance motors.

Total: 45

TEXT BOOKS

1. Charles Kingsley, A.E. Fitzgerald Jr. and Stephen D. Umans, 'Electric Machinery', Tata McGraw-Hill, Fifth Edition, 1992.
2. R. Krishnan, 'Electric Motor & Drives: Modelling, Analysis and Control', Prentice Hall of India, 2001.

REFERENCES

1. C.V. Jones, 'The Unified Theory of Electrical Machines', Butterworth, 1967.
2. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives' Clarendon Press, 1989.

PE5102 – ADVANCED POWER SEMICONDUCTOR DEVICES

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION 9

Power switching devices overview - attributes of an ideal switch - application requirements - circuit symbols - power handling capability - SOA - device selection strategy - on-state and switching losses - EMI due to switching - power diodes - types - forward and reverse characteristics - switching characteristics - rating.

UNIT II CURRENT CONTROLLED DEVICES 9

BJT's - construction - static characteristics - switching characteristics - negative temperature co-efficient and secondary breakdown - power Darlington - thyristors - physical and electrical principle underlying operating mode - two transistor analogy - concept of latching - gate and switching characteristics - converter grade and inverter grade and other types - series and parallel operation - comparison of BJT and thyristor - steady state and dynamic models of BJT and thyristor.

UNIT III VOLTAGE CONTROLLED DEVICES 9

Power MOSFETs and IGBTs - principle of voltage controlled devices - construction - types - static and switching characteristics - steady state and dynamic models of MOSFET and IGBTs - basics of GTO, MCT, FCT, RCT and IGCT.

UNIT IV FIRING AND PROTECTING CIRCUITS 9

Necessity of isolation - pulse transformer - optocoupler - gate drives circuit - SCR, MOSFET, IGBTs and base driving for power BJT - over voltage - over current and gate protections - design of snubbers.

UNIT V THERMAL PROTECTION 9

Heat transfer - conduction, convection and radiation - cooling - liquid cooling - vapour - phase cooling - guidance for heat sink selection - thermal resistance and impedance - electrical analogy of thermal components - heat sink types and design - mounting types.

Total: 45

TEXT BOOKS

1. B.W Williams 'Power Electronics Circuit Devices and Applications', New York, Halsted Press, 1987.
2. M.H. Rashid, 'Power Electronics Circuits, Devices and Applications', Prentice Hall of India, Third Edition, 2004.

REFERENCES

1. M.D. Singh and K.B Khanchandani, 'Power Electronics', Tata McGraw-Hill, 2001.
2. Mohan, Undeland and Robins, 'Power Electronics - Concepts, Applications and Design', John Wiley & Sons, 2000.

PE5103 – ANALYSIS OF POWER CONVERTERS

L	T	P	C
3	0	0	3

UNIT I SINGLE PHASE AC-DC CONVERTER 9

Uncontrolled - half controlled and fully controlled converters with R-L, R-L-E loads and free wheeling diodes - continuous and discontinuous models of operation - inverter operation - dual converter - sequence control of converters - performance parameters - harmonics - ripple - distortion - power factor - effect of source impedance and overlap.

UNIT II THREE PHASE AC-DC CONVERTER 9

Uncontrolled and fully controlled - converter with R, R-L, R-L-E - loads and free wheeling diodes - inverter operation and its limit - dual inverter - performance parameters - effect of source impedance and over lap

UNIT III 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.

UNIT IV AC VOLTAGE CONTROLLERS 9

Principle of phase control - single phase and three phase controllers - various configurations - analysis with R and R-L loads.

UNIT V CYCLOCONVERTERS 9

Principle of operation - single phase and three phase cycloconverters - power circuits and gating signals.

Total: 45

TEXT BOOKS

1. Ned Mohan, Undeland and Robbin, 'Power Electronics: Converters, Application and Design' John Wiley & Sons Inc., New York, 1995.
2. M.H. Rashid, 'Power Electronics Circuits, Devices and Applications', Prentice Hall of India, 1995.

REFERENCES

1. P.C Sen., 'Modern Power Electronics', Wheeler Publishing Co., First Edition, 1998.
2. P.S. Bimbra, 'Power Electronics', Khanna Publishers, Eleventh Edition, 2003.

PE5104 – ANALYSIS OF INVERTERS

L	T	P	C
3	0	0	3

UNIT I SINGLE PHASE INVERTERS 9

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.

UNIT II 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.

UNIT III 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

UNIT IV MULTILEVEL INVERTERS 9

Multilevel concept - diode clamped - flying capacitor - cascade type multilevel inverters - comparison of multilevel inverters - application of multilevel inverters

UNIT V RESONANT INVERTERS 9

Series and parallel resonant inverters - voltage control of resonant inverters - class E resonant inverter - resonant D.C. - link inverters.

Total: 45

TEXT BOOKS

1. M.H. Rashid, 'Power Electronics Circuits, Devices and Applications', Prentice Hall of India, Third Edition, 2004.
2. Jai P. Agarwal, 'Power Electronics Systems', Pearson Education, Second Edition, 2002.

REFERENCES

1. P.C. Sen, 'Modern Power Electronics', Wheeler Publishing Co., First Edition, 1998.
2. P.S. Bimbra, 'Power Electronics', Khanna Publishers, Eleventh Edition, 2003.
3. Bimal K. Bose 'Modern Power Electronics and AC Drives', Pearson Education, Second Edition, 2003.

SEMESTER II

PE5151 – COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS

L	T	P	C
3	1	0	4

UNIT I INTRODUCTION 5

Conventional design procedures - limitations - need for field analysis based design.

UNIT II MATHEMATICAL FORMULATION OF FIELD PROBLEMS 10

Electromagnetic field equations - magnetic vector/scalar potential - electrical vector/scalar potential - stored energy in field problems - inductance - development of torque/force - Laplace and Poisson's equations - energy functional - principle of energy conversion.

UNIT III 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.

UNIT IV CAD PACKAGES 10

Elements of a CAD System - pre-processing - modelling - meshing - material properties - boundary conditions - setting up solution - post processing.

UNIT V DESIGN APPLICATIONS 10

Design of solenoid actuator - induction motor - insulators - power transformer.

L: 45 T: 15 Total: 60

TEXT BOOKS

1. S.J. Salon, "Finite Element Analysis of Electrical Machines" Kluwer Academic Publishers, 1995.
2. S.R.H. Hoole, "Computer - Aided, Analysis and Design of Electromagnetic Devices", Elsevier, 1989.

REFERENCES

1. P.P. Silvester and Ferrari, 'Finite Elements for Electrical Engineers' Press, 1983.
2. D.A. Lowther and P.P. Silvester, "Computer Aided Design in Magnetic", Springer Verlag, 1986.

PE5152 – SOLID STATE D.C. DRIVES

L	T	P	C
3	0	0	3

UNIT I DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS 9

DC motor - types - induced E.M.F. - speed-torque relations - speed control - armature and field speed control - Ward Leonard control - constant torque and constant horse power operations - 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.

UNIT II CONVERTER CONTROL 9

Principle of phase control - fundamental relations - analysis of series and separately excited D.C. 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 free wheeling diode - implementation of braking schemes - drive employing dual converter.

UNIT III CHOPPER CONTROL 9

Introduction to time ratio control and frequency modulation - class A, B, C, D and E chopper controlled D.C. motor - performance analysis - multi-quadrant control - chopper based implementation of braking schemes - multi-phase chopper - related problems.

UNIT IV CLOSED LOOP CONTROL 9

Modeling of drive elements - equivalent circuit - transfer function of self - separately excited D.C. 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.

UNIT V DIGITAL CONTROL OF DC DRIVE 9

Phase locked loop and micro-computer control of D.C. drives - program flow chart for constant horse power and load disturbed operations - speed detection and gate firing.

Total: 45

TEXT BOOKS

1. Gopal K. Dubey, 'Power Semiconductor Controlled Drives', Prentice Hall Inc.,1989.
2. R. Krishnan, 'Electric Motor Drives - Modeling, Analysis and Control', Prentice Hall of India, 2003.

REFERENCES

1. Gopal K. Dubey, 'Fundamentals of Electrical Drives', Narosa Publishing House, 2001.
2. Bimal K. Bose 'Modern Power Electronics and AC Drives', Pearson Education, 2003.
3. Vedam Subramanyam, 'Electric Drives - Concepts and Applications', Tata McGraw-Hill, 2002.
4. P.C. Sen, 'Thyristor DC Drives', John Wiley & Sons, 1981.

PE5153 – SOLID STATE A.C. DRIVES

L	T	P	C
3	0	0	3

UNIT I CONVENTIONAL CONTROL OF INDUCTION MOTORS 9

Review of induction machine operation - equivalent circuit - performance of the machine with variable voltage - rotor resistance variation - pole changing and cascaded induction machines - slip power recovery - static Kramer drive.

UNIT II VSI AND CSI FED INDUCTION MOTOR CONTROL 9

A.C. voltage controller fed induction machine operation - energy conservation issues - v/f operation theory - requirement for slip and stator voltage compensation - CSI fed induction machine - operation and characteristics.

UNIT III FIELD ORIENTED CONTROL 9

Field oriented control of induction machines - theory - D.C. drive analogy - direct and indirect methods - flux vector estimation.

UNIT IV DIRECT TORQUE CONTROL 9

Direct torque control of induction machines - torque expression with stator and rotor fluxes - DTC control strategy.

UNIT V SYNCHRONOUS MOTOR CONTROL 9

Synchronous motor control - brush and brushless excitation - load commutated inverter fed drive.

Total: 45

TEXT BOOKS

1. Bimal K Bose, 'Modern Power Electronics and AC Drives', Pearson Education, 2002.
2. Vedam Subramanyam, 'Electric Drives - Concepts and Applications', Tata McGraw-Hill, 1994.

REFERENCES

1. W. Leonhard, 'Control of Electrical Drives', Narosa Publishing House, 1992.
2. J.M.D. Murphy and Turnbull, 'Thyristor Control of AC Motors', Pergamon Press, Oxford, 1988.

PE5154 – EMBEDDED CONTROL OF ELECTRICAL DRIVES

L	T	P	C
3	0	0	3

UNIT I MC68HC11 MICROCONTROLLER 9

Architecture memory organization - addressing modes - instruction set - programming techniques - simple programs.

UNIT II PERIPHERALS OF MC68HC11 9

I/O ports - handshaking techniques - reset and interrupts - serial communication interface - serial peripheral interface - programmable timer - analog / digital interfacing - cache memory.

UNIT III PIC 16C7X MICROCONTROLLER 9

Architecture - memory organization - addressing modes - instruction set - programming techniques - simple operation.

UNIT IV PERIPHERAL OF PIC 16C7X MICROCONTROLLER 9

Timers - interrupts - I/O ports - I²C bus for peripheral chip access - A/D converter - VART

UNIT V SYSTEM DESIGN USING MICROCONTROLLERS 9

Interfacing LCD display - keypad interfacing - A.C. load control - PID control of D.C. motor - stepper motor control - brush less D.C. motor control.

Total: 45

TEXT BOOKS

1. John B. Peatman , 'Design with PIC Microcontrollers,' Pearson Education, 2004.
2. Michael Khevi, 'The M68HC11 Microcontroller Applications in Control, Instrumentation and Communication', Prentice Hall, 1997.

REFERENCE

1. John B. Peatman, 'Design with Microcontrollers', McGraw-Hill, 1988.

PE5155 – POWER ELECTRONICS AND DRIVES LABORATORY

L	T	P	C
0	0	3	2

1. Single phase semi-converter with R-L and R-L-E loads for continuous and discontinuous conduction modes
2. Single phase full-converter with R-L and R-L-E loads for continuous and discontinuous conduction modes
3. Three phase full-converter with R-L-E load
4. MOSFET - IGBT based choppers
5. IGBT based single phase inverters
6. Single phase A.C. voltage controller
7. Simulation of closed loop control of converter fed D.C. motor drive
8. Simulation of closed loop control of chopper fed D.C. motor drive
9. Simulation of VSI fed three phase induction motor drive
10. Simulation of three phase synchronous motor and drive

Total: 45

SEMESTER III

PE5251 – PROJECT WORK PHASE I

L	T	P	C
0	0	12	6

PE5251 – PROJECT WORK PHASE II

L	T	P	C
0	0	24	12

PE5002 – COMPUTER COMMUNICATION AND NETWORKS

L	T	P	C
3	0	0	3

UNIT I COMPUTER NETWORKS 9

Evolution of data networks - network architecture - ISO reference model examples of networks - application of networks - physical layer - communication medium characteristics.

UNIT II MEDIUM ACCESS SUB LAYER AND DATA LINK LAYER 9

Local area networks - conventional channel allocation methods - pure-ALOHA - S-ALOHA - finite population ALOHA - controlled ALOHA - reservation ALOHA - design issues for packet radio networks - IEEE standard for LAN-ethernet - CSMA/CD LAN - token passing ring - data link layer design issues - service primitives - stop and wait sliding window protocols - comparison of stop and wait and sliding window protocols.

UNIT III NETWORK AND TRANSPORT LAYERS 9

Network layer design issues routing algorithm - congestion control algorithms internetworking - transport layer design issues - connection management - a simple transport protocol on top of X.25.

UNIT IV QUEUING THEORY AND CAPACITY ASSIGNMENT 9

M/M/I Queues/G/I Queues - priority queuing capacity assignment for terminal networks and distributed networks - concentration and buffering for finite and infinite buffers and block storage.

UNIT V PRESENTATION LAYER AND APPLICATION LAYER 9

Design issues - abstract syntax notation - data compression techniques - cryptography - remote procedure call - design Issues - file transfer access and management - electronic mail - virtual terminals - other applications.

Total: 45

TEXT BOOKS

1. Andrew S. Tanenbaum, 'Computer Networks', Fourth Edition, Prentice Hall of India, 2003.
2. D. Bertsekas and R. Gallager, 'Data Networks', Second Edition, Prentice Hall of India, 2003.

REFERENCES

1. Godbole and Kahate, 'Computer Communication Networks (Ascent Series)', McGraw-Hill, 2003.
2. M. Schwartz, 'Computer Communications', Tata McGraw-Hill, 2002.
3. Achyut S. Godbole, 'Data Communications and Networking', Tata McGraw-Hill, 2002.
4. W. Stallings, 'Data and Computer Communication', Second Edition, Macmillan, 1998.

UNIT I OVERVIEW OF SOFTWARE ENGINEERING 9

Introduction - FAQs about software engineering - professional and ethical responsibility - computer-based system engineering - emerging system properties - system and their environment - system modeling - system engineering process - system procurement - software processes - process models - process iteration - software specification - software design - software validation - software evolution - automated process support - project management - management activities - project planning - project scheduling - risk management.

UNIT II REQUIREMENTS 9

Functional and non-functional requirements - user requirements - system requirements - software requirements document - requirements engineering processes - feasibility studies - requirements elicitation and analysis - requirements - validation - requirements management - system models - context models - behavioral models - data models - object Models - CASE workbenches - software prototyping - prototyping in the software process - rapid prototyping techniques - user interface prototyping - formal specification - formal specification in the software process - interface specification - behavioral specification.

UNIT III ARCHITECTURE AND SOFTWARE DESIGN 9

System structuring - repository model - client server model - abstract machine model - control models - modular decomposition - domain-specific software architecture - distributed system architectures - multiprocessor architectures - client server architectures - CORBA - object-oriented design - objects and object classes - object oriented design process - design evolution - real-time software design - system design - real-time executives - monitoring and control systems - design with reuse - component-based development - application families - design patterns - user interface design - user interface design principles - user interaction - information presentation - user support interface evaluation.

UNIT IV CRITICAL SYSTEMS AND DEPENDABILITY 9

Critical systems - availability and reliability - safety - security - critical systems specification and development - software reliability specification - safety specification - security specification - fault minimization - fault tolerance - fault-tolerant architectures - safe system design - verification and validation planning - automated static analysis - clean room software development - software testing - defect testing - integration testing - object oriented testing - testing workbenches - critical systems validation - formal methods and critical systems - reliability validation - safety assurance - security assessment.

UNIT V SOFTWARE COST ESTIMATION 9

Productivity - estimation techniques - algorithmic cost modeling - project duration and staffing - quality management - quality assurance and standards - quality planning - quality control - software measurement and metrics - process improvement - process and product quality - process analysis and modeling - process measurement - the SEI process capability maturity model - process classification.

Total: 45

TEXT BOOK

1. Ian Sommerville, 'Software Engineering', Sixth Edition, Pearson Education, 2001.

REFERENCES

1. Jawadkar, 'Software Engineering', Tata McGraw-Hill, 2004.
2. Fairley, 'Software Engineering Concepts', Tata McGraw-Hill, 2004.

PS5051 – INTELLIGENT CONTROL

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION 9

Approaches to intelligent control - architecture for intelligent control - symbolic reasoning system - rule-based systems - the AI approach - knowledge representation - expert systems.

UNIT II 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

UNIT III GENETIC ALGORITHM 9

Basic concept of genetic algorithm and detail algorithmic steps - adjustment of free parameters - solution of typical control problems using genetic algorithm - concept on some other search techniques like Tabu search and ant-colony search techniques for solving optimization problems.

UNIT IV 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.

UNIT V APPLICATIONS 9

GA application to power system optimisation problem - case studies - identification and control of linear and nonlinear dynamic systems using Matlab - neural network toolbox - stability analysis of neural network interconnection systems - implementation of fuzzy logic controller using Matlab - fuzzy logic toolbox - stability analysis of fuzzy control systems.

Total: 45

REFERENCES

1. Jacek M. Zurada, 'Introduction to Artificial Neural Systems', Jaico Publishing House, 1999.
2. B. Kosko, 'Neural Networks and Fuzzy Systems', Prentice Hall of India, 1994.
3. G.J. Klir and T.A. Folger, 'Fuzzy Sets, Uncertainty and Information', Prentice Hall of India, 1993.
4. H.J. Zimmerman 'Fuzzy Set Theory and its Applications', Kluwer Academic Publishers, 1994.
5. D. Driankov, H. Hellendoorn and M. Reinfrank, 'An Introduction to Fuzzy Control', Narosa Publishing House, 1993.

PS5003 – FLEXIBLE AC TRANSMISSION SYSTEMS

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION 9

Reactive power control in electrical power transmission lines - uncompensated line - series compensation - basic concepts of SVC - thyristor controlled series capacitor - unified power flow controller.

UNIT II STATICVAR COMPENSATOR AND APPLICATIONS 9

Voltage control by SVC - advantages of slope in dynamic characteristics - influence of SVC on system voltage - design of SVC voltage regulator - applications enhancement of transient stability - steady state power transfer - enhancement of power damping - prevention of voltage instability.

UNIT III TCSC 9

Operation of the TCSC - different modes of operation - modelling of TCSC variable reactance model - modelling for stability studies - applications - improvement of system stability limit - enhancement of system damping - voltage collapse prevention.

UNIT IV EMERGING FACTS CONTROLLER 9

STATCOM - principle of operation - VI characteristics - UPFC - principle of operation - modes of operation - applications - modelling of UPFC for power flow studies.

UNIT V COORDINATION OF FACTS CONTROLLER 9

Controller interactions - SVC - SVC interaction coordination of multiple controllers using LC tech - control coordination using GA.

Total: 45

REFERENCES

1. R. Mohan Mathur and Rajiv K. Varma, 'Thyristor - Based FACTS Controller for Electrical Transmission Systems', Wiley Interscience, IEEE Press, 2002.
2. Narin G. Hingorani and L. Gyuguyi, 'Understanding FACTS Concepts and Technology of FACTS', IEEE Press, 2000.

CI5052 – DIGITAL SIGNAL PROCESSORS

L	T	P	C
3	0	0	3

UNIT I	INTRODUCTION	9
Algorithms for signal processing - basic architecture of DSPs		
UNIT II	TEXAS PROCESSORS	9
Architecture - addressing modes - instruction set - programming		
UNIT III	PERIPHERALS INTERFACES OF DSP	9
Peripherals - memory - applications		
UNIT IV	EXTERNAL INTERFACE	9
Digital and analog interface - host interface - memory interface - DMA ports - serial ports.		
UNIT V	SPECIAL PROCESSORS FOR MOTOR CONTROL	9
Architecture - special features - PWM generation - controller implementation		

Total: 45

REFERENCES

1. B. Venkataramani and M. Bhaskar, 'Digital Signal Processor - Architecture, Programming and Applications', Tata McGraw-Hill, 2002.
2. K. Padmanabhan, S. Ananthi and H. Vijayarasan, 'A Practical approach to Digital Signal Processing', New Age Publishers, 2001.
3. Texas Instruments - Manuals.

PS5002 – HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

L	T	P	C
3	0	0	3

UNIT I D.C. POWER TRANSMISSION TECHNOLOGY 9

Introduction - comparison of A.C. and D.C. transmission application of D.C. transmission - description of D.C. transmission system planning for HVDC transmission - modern trends in D.C. transmission.

UNIT II ANALYSIS OF HVDC CONVERTERS 9

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

UNIT III CONVERTER AND HVDC SYSTEM CONTROL 9

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

UNIT IV HARMONICS AND FILTERS 9

Introduction - generation of harmonics - design of A.C. filters - D.C. filters - carrier frequency and RI noise.

UNIT V SIMULATION OF HVDC SYSTEMS 9

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

Total: 45

REFERENCES

1. K.R. Padiyar, 'HVDC Power Transmission System', Wiley Eastern Ltd., First Edition, 1990.
2. Edward Wilson Kimbark, 'Direct Current Transmission', Vol.I, Wiley Interscience, New York, 1971.
3. Rakosh Das Begamudre, 'Extra High Voltage AC Transmission Engineering' New Age International Publishers, 1990.
4. J. Arrillaga, 'High Voltage Direct Current Transmission', Peter Pregrinus, London, 1983.

CI5101 – LINEAR AND NON-LINEAR SYSTEMS THEORY

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UNIT I PHYSICAL SYSTEMS AND STATE ASSIGNMENT 9

Systems - electrical - mechanical - hydraulic - pneumatic - thermal systems - modelling of some typical systems like D.C. Machines - inverted pendulum.

UNIT II STATE SPACE ANALYSIS 9

Realisation of state models - non-uniqueness - minimal realisation - balanced realisation - solution of state equations - state transition matrix and its properties - free and forced responses - properties - controllability and observability - stabilisability and detectability - Kalman decomposition.

UNIT III MIMO SYSTEMS - 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 - bandwidth - Nyquist plots - singular value analysis.

UNIT IV NON-LINEAR SYSTEMS 9

Types of non-linearity - typical examples - equivalent linearization - phase plane analysis - limit cycles - describing functions - analysis using describing functions - jump resonance.

UNIT V STABILITY 9

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

Total: 45

REFERENCES

1. M. Gopal, 'Modern Control Engineering', Wiley, 1996.
2. J.S. Bay, 'Linear State Space Systems', McGraw-Hill, 1999.
3. Eroni-Umez and Eroni, 'System dynamics & Control', Thomson Brooks / Cole, 1998.
4. K. Ogatta, 'Modern Control Engineering', Pearson Education, Low Priced Edition, 1997.
5. G.J. Thaler, 'Automatic control systems', Jaico publishers, 1993.
6. John S. Bay, 'Linear State Space Systems', McGraw-Hill International Edition, 1999.

CI5102 – DIGITAL SIGNAL PROCESSING

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UNIT I DISCRETE TIME SIGNALS AND SYSTEMS 9

Representation of discrete time signal - classifications - discrete time - system - basic operations on sequence - linear - time invariant - causal - stable - solution to difference equation - convolution sum - correlation - discrete time Fourier series - discrete time Fourier transform.

UNIT II FOURIER AND STRUCTURE REALIZATION 9

Discrete Fourier transform - properties - fast Fourier transform - Z-transform - structure realization - direct form - lattice structure for FIR filter - lattice structure for IIR Filter.

UNIT III FILTERS 9

FIR Filter - windowing technique - optimum equiripple linear phase FIR filter - IIR filter - bilinear transformation technique - impulse invariance method - Butterworth filter - Tchebyshev filter.

UNIT IV MULTISTAGE REPRESENTATION 9

Sampling of band pass signal - antialiasing filter - decimation by an integer factor - interpolation by an integer factor - sampling rate conversion - implementation of digital filter banks - sub-band coding - quadrature mirror filter - A/D conversion - quantization - coding - D/A conversion - introduction to wavelets.

UNIT V DIGITAL SIGNAL PROCESSORS 9

Fundamentals of fixed point DSP architecture - fixed point number representation and computation - fundamentals of floating point DSP architecture - floating point number representation and computation - study of TMS 320 C 50 processor - basic programming - addition - subtraction - multiplication - convolution - correlation - study of TMS 320 C 54 processor - basic programming - addition - subtraction - multiplication - convolution - correlation.

Total: 45

REFERENCES

1. John G. Proakis and Dimitris G. Manolakis, 'Digital Signal Processing: Principles, Algorithms and Applications', Prentice Hall of India.
2. S. Salivahanan, A. Vallavaraj and C. Gnanapriya 'Digital Signal Processing', Tata McGraw-Hill, 2000.
3. A.V. Oppenheim and R.W. Schaffer 'Digital Signal Processing', Prentice Hall, Inc, New Jersey, 1975.
4. Rabiner and Gold, 'Theory and Application of Digital Signal Processing', A comprehensive, Industrial - Strength DSP reference book, Prentice Hall.
5. B. Venkatramani and M. Bhaskar, 'Digital Signal Processors Architecture, Programming and Applications', Tata McGraw-Hill, 2002.