St. PETER'S UNIVERSITY

St. Peter's Institute of Higher Education and Research
(Declared under section 3 of UGC Act 1956)
Avadi, Chennai – 600 054.

M.E. (POWER ELECTRONICS AND DRIVES) PROGRAMME

(I TO IV SEMESTERS)

REGULATIONS AND SYLLABI

(REGULATIONS – 2008)

M.E. (POWER ELECTRONICS AND DRIVES) PROGRAMME

Regulations and Syllabi

(Effective from 2008)

1. **Eligibility:** Candidates who passed B.E. / B.Tech. (EEE / ECE / EIE) of the University or any other equivalent examination thereto are eligible for admission to Two Year M.E. (Power Electronics and Drives) Programme.

2. **Duration:** Two Years Comprising 4 Semesters. Each semester has a minimum 90 working days with a minimum of 5 hours a day.

3. **Medium:** English is the medium of instruction and examination.

4. **Weightage for Internal and End Assessment:** The weightage for Internal Assessment (IA) and End Assessment (EA) be 25:75 unless the ratio is specifically mentioned in the scheme of Examinations.

5. **Credit System:** Credit system be followed with 18 credits for each semester and each credit is equivalent to 25-30 hours of effective study provided in the Time Table.

6. **Scheme of Examinations (I to IV Semesters)**

I Semester

Code No.	Course Title	Credit	Marks		
Theory			**IA**	**EA**	**Total**
108PEPT01	Applied Mathematics for Electrical Engineers	3	25	75	100
108PEPT02	Modeling and Analysis of Electrical Machines	3	25	75	100
108PEPT03	Advanced Power Semiconductor Devices	3	25	75	100
108PEPT04	Analysis of Power Converters	3	25	75	100
108PEPT05	Analysis of Inverters	3	25	75	100
108PEPT06	Special Electrical Machines	3	25	75	100
	Total	**18**	**150**	**450**	**600**

II Semester

Code No.	Course Title	Credit	Marks		
Theory			**IA**	**EA**	**Total**
208PEPT01	Computer Aided Design of Electrical Apparatus	3	25	75	100
208PEPT02	Solid State DC Drives	2	25	75	100
208PEPT03	Solid State AC Drives	2	25	75	100
208PEPT04	Embedded Control of Electrical Drives	3	25	75	100
Electives					
208PEPT05	**Elective I :** High Voltage Direct Current Transmission	3	25	75	100
208PEPT06	**Elective II:** Software Engineering & Architecture	3	25	75	100
Practical					
208PEPP01	Power Electronics and Drives Lab	2	25	75	100
	Total	**18**	**175**	**525**	**700**

III Semester

Code No.	Course Title	Credit	Marks		
Theory			**IA**	**EA**	**Total**
308PEPE01	**Elective III**: Computer Communication & Networks	2	25	75	100
308PEPE04	**Elective I**V: Flexible AC Transmission System	2	25	75	100
308PEPE07	**Elective V** Digital Signal Processing	2	25	75	100
Practical					
308PEPP01	Project Work – (Phase –I)*	12	25	65	100
	Viva voce			10	
	Total	**18**	**100**	**300**	**400**

***** Candidates who have completed Project work (Phase I) successfully are eligible for Project Work (Phase - II) Examination.

IV Semester

Code No.	Course Title	Credit	Marks		
Project			**IA**	**EA**	**Total**
408PEPP01	Project Work (Phase-II)*	18	25	65	100
	Viva voce			10	
	Total	**18**	**25**	**75**	**100**

LIST OF ELECTIVE COURSES

S.No	Electives
1.	**Computer Communication and Networks**
2.	**Software Engineering and Architecture**
3.	**High Voltage Direct Current Transmission**
4.	**Flexible AC Transmission Systems**
5.	Intelligent Control
6.	Linear and Non-linear Systems Theory
7.	**Digital Signal Processing**
8.	Digital signal processors

7. Passing Requirements: The minimum pass mark (raw score) be 50% in End Assessment (EA) and 50% in Continuous Assessment (CA) and End Assessment (EA) put together. No minimum mark (raw score) in Continuous Assessment (CA) be prescribed unless it is specifically mentioned in the Scheme of Examination.

8. Grading System: Grading System on a 10 Point Scale be followed with 1 mark = 0.1 Grade point to successful candidates as given below.

CONVERSION TABLE

(1 mark = 0.1 Grade Point on a 10 Point Scale)

Range of Marks	Grade Point	Letter Grade	Classification
90 to 100	9.0 to 10.0	O	First Class
80 to 89	8.0 to 8.9	A	First Class
70 to 79	7.0 to 7.9	B	First Class
60 to 69	6.0 to 6.9	C	First Class
50 to 59	5.0 to 5.9	D	Second Class
0 to 49	0 to 4.9	**F**	**Reappearance**

Procedure for Calculation

Cumulative Grade Point Average (CGPA)	=	$\frac{\text{Sum of Weighted Grade Points}}{\text{Total Credits}}$
	=	$\frac{\sum (CA+EA)\ C}{\sum C}$
Where Weighted Grade Points in each Course	=	Grade Points (CA+EA) multiplied by Credits
	=	(CA+EA)C
Weighted Cumulative Percentage of Marks(WCPM)	=	CGPAx10

C- Credit, CA-Continuous Assessment, EA- End Assessment

9. Pattern of the Question Paper: The question paper for End Assessment will be set for three hours and for the maximum of 100 marks with following divisions and details.

Part A: 10 questions (with equal distribution to all units in the syllabus). Each question carries 2 marks.

Part B: 5 questions with either or type (with equal distribution to all units in the syllabus). Each question carries 16 marks.

The total marks scored by the candidates will be reduced to the maximum prescribed in the Regulations.

10. Effective Period of Operation for the Arrear Candidates : Two Year grace period is provided for the candidates to complete the arrear examination, if any.

Registrar

11. Syllabus

SEMESTER - I

108PEPT01 – APPLIED MATHEMATICS

Unit I CALCULAS OF VARIATION

Introduction – Euler's equation – several dependent variables Lagrange's equation of Dynamics – Integrals involving derivatives higher that the first – Problem with constrains – Direct methods and eigen value problems.

Unit II MATRIX THEORY

Eigen values using QR transformations – generalized eigenvectors – canonical forms – singular value decomposition and applications – pseudo inverse – least square approximations.

Unit III LINEAR PROGRAMMING PROBLEM

Graphical method – simplex method – Big M Technique – Integer programming.

Unit IV LINEAR PROGRAMMING PROBLEM AND SIMULATION THEORY

Transportation Problem – Assignment Problem – Simulation.

UNIT V RANDOM PROCESSES

Classification – Stationary Random process – Markov process – Gaussian process – Markov chain – Auto Correction – Cross correlation – response of linear system to random input.

REFERENCE:

1. Gupta, A.S, Calculus of variations with Applications, Prentice – Hall of India New Delhi, 1997.
2. Broson, R., Matrix operations, Schaum's outline series, McGraw Hill, New York, 1989.
3. Taha H.A, "Operation Research – An Introduction", Prentice Hall of India, 2001.
4. Ochi, M.K, "Applied Probability and stochastic Processes", John Wiley & Sons (1992).

108PEPT02 – MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

1. PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION

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

2. BASIC CONCEPTS OF ROTATING MACHINES

Calculation of air gap mmf and per phase machine inductance using physical machine data. Voltage and torque equation of dc machine, three phase symmetrical induction machine and salient pole synchronous machines in phase variable form.

3. INTRODUCTION TO REFERENCE FRAME THEORY

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.

4. DETERMINATION OF SYNCHRONOUS MACHINE DYNAMIC EQUIVALENT CIRCUIT PARAMETERS

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

5. SPECIAL MACHINES

Permanent magnet synchronous machine: Surface permanent magnet (square and sinusoidal back emf type) and interior permanent magnet machines. Construction and operating principle, dynamic modeling and self controlled operation. Analysis of Switch Reluctance Motors.

TEXT BOOKS

1. Charles Kingsley, Jr., A.E. Fitzgerald, 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, London, 1967.
2. Miller, T.J.E. "Brushless permanent magnet and reluctance motor drives" Clarendon Press, Oxford, 1989.

108PEPT03 – ADVANCED POWER SEMICONDUCTOR DEVICES

1. INTRODUCTION

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.

2. CURRENT CONTROLLED DEVICES

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 & Thyristor.

3. VOLTAGE CONTROLLED DEVICES

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.

4. FIRING AND PROTECTING CIRCUITS

Necessity of isolation, pulse transformer, optocopler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT – Over voltage, over current and gate protections. Design of snubbers.

5. THERMAL PROTECTION

Heat transfer – conduction, convection and radiation. Cooling – liquid cooling, vapour – phase cooling. Guidance for hear sink selection – Thermal resistance and impedance – Electrical analogy of thermal components, heat sink types and design – Mounting types.

TEXT BOOKS

1. B.W. Williams ' Power Electronics Circuit Devices and Applications'.
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi, 2004.

REFERENCES

1. MD Singh and K.B Khanchandani, "Power Electronics", Tata McGraw Hill, 2001.
2. Mohan, Undcland and Robins, "Power Electronics Concepts applications and Design, John Wiley and Sons, Singapore, 2000.

108PEPT04 – ANALYSIS OF POWER CONVERTERS

1. SINGLE PHASE AC-DC CONVERTER

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.

2. THREE PHASE AC-DC CONVERTER

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.

3. DC-DC CONVERTERS

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.

4. AC VOLTAGE CONTROLLERS

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

5. CYCLOCONVERTERS

Principle of operation – Single phase and three phase cycloconverters – power circuits and gating signals.

TEXT BOOKS

1. Ned Mohan, Undeland and Robbin, "Power Electronics: converter, Application and design" John Wiley and sons Inc, Newyork, 1995.
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, New Delhi, 1995.

REFERENCES

1. P.C. Sen., "Modern Power Electronics", Wheeler publishing Co, First Edition, New Delhi – 1998.
2. P.S.Bimbra, "Power Electronics", Khanna Publishers, Eleventh Edition, 2003.

108PEPT05 – ANALYSIS OF INVERTERS

1. SINGLE PHASE INVERTERS

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.

2. THREE PHASE VOLTAGE SOURCE INVERTERS

180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters.

3. CURRENT SOURCE INVERTERS

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.

4. MULTILELVEL INVERTERS

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

5. RESONANT INVERTERS

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

TEXT BOOKS

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi, 2004.
2. Jai P. Agrawal, "Power Electronics Systems", Pearson Education, Second Edition, 2002.

REFERENCES

1. P.C. Sen, "Modern Power Electronics", Wheeler Publishing Co., First Edition, New Delhi, 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.

108PEPT06 – SPECIAL ELECTRICAL MACHINES

1. SYNCHRONOUS RELUCTANCE MOTORS

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

2. SWITCHED RELUCTANCE MOTORS

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

3. PERMANENT MAGNET SYNCHRONOUS MOTORS

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

4. PERMANENT MAGNET BRUSHLESS DC MOTORS

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 – Microprocessor based controller.

5. STEPPING MOTORS

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.

TEXT BOOKS

1. Miller, T.J.E. "Brushless permanent magnet and reluctance motor drives", Clarendon Press, Oxford, 1989.
2. Kenjo, T, "Stepping motors and their microprocessor control", Clarendon Press, Oxford, 1989.

REFERENCES

1. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, 1989.
2. Kenjo, T. Power Electronics for the microprocessor Age, 1989.
3. B.K. Bose, "Modern Power Electronics & AC drives".
4. R. Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt., Ltd., New Delhi, 2002.

208PEPT01 – COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS

1. INTRODUCTION

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

2. MATHEMATICAL FORMULATION OF FIELD PROBLEMS

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.

3. PHILOSOPHY OF FEM

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

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

5. DESIGN APPLICATIONS

Design of Solenoid Actuator – Induction Motor – Insulators – Power transformer.

TEXT BOOKS

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

REFERENCES

1. P.P. Silverster and Ferrari, "Finite Elements for Electrical Engineers" Cambridge University press, 1983.
2. D.A. Lowther and P.P. Silvester, Computer Aided Design in Magnetics, Springer verlag, New York, 1986.

208PEPT02 – SOLID STATE DC DRIVES

1. DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS

DC motor – Types induced emf, speed – torque relations; Speed control – Armature and field speed control; Water 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.

2. CONVERTER CONTROL

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 free wheeling diode; Implementation of braking schemes; Drive employing dual converter.

3. CHOPPER CONTROL

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.

4. CLOSED LOOP CONTROL

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.cm drive.

5. DIGITAL CONTROL OF D.C DRIVE

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.

TEXT BOOKS

1. Gopal K Dubey, "Power Semiconductor controlled Drives", Prentice Hall Inc., New Yersy, 1989.
2. R. Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt., Ltd., New Delhi, 2003.

REFERENCES

1. Gobal K.Dubey, "Fundamentals of Electrical Drives", Narosal Publishing House, New Delhi, 2001.
2. Bimal K. Bose "Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003.
3. Vedam Subramanyam, "Electric Drives – Concepts and Applications", Tata McGraw-Hill publishing company Ltd., New Delhi, 2002.
4. P.C Sen "Thyristor DC Drives", John wiley and sons, New York, 1981.

208PEPT03 – SOLID STATE AC DRIVES

1. CONVENTIONAL CONTROL OF INDUCTION MOTORS

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 – State Kramer Drive.

2. VSI AND CSI FED INDUCTION MOTOR CONTROL

AC 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.

3. FIELD ORIENTED CONTROL

Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods. Flux vector estimation.

4. DIRECT TORQUE CONTROL

Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy.

5. SYNCHRONOUS MOTOR CONTROL

Synchronous motor control – Brush and Brushless excitation – Load commutated inverter fed drive.

TEXT BOOKS

1. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education Asia 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. Murphy J.M.D and Turnbull, "Thyristor Control of AC Motors", Pergamon Press, Oxford, 1988.

208PEPT04 – ENBEDDED CONTROL OF ELECTRICAL DRIVES

1. MC68HC11 MICROCONTROLLER

Architecture memory organization – Addressing modes – Instruction set – Programming techniques simple programs.

2. PERIPHERALS OF MC68HC11

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

3. PIC 16C7X MICROCONTROLLER

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

4. PERIPHERAL OF PIC 16C7X MICROCONTROLLER

Timers – interrupts – I/O ports – I^2 C bus for peripheral chip access – A/D converter – VART.

5. SYSTEM DESIGN USING MICROCONTROLLERS

Interfacing LCD display – Keypad interfacing – AC load control – PID control of DC motor stepper motor control brush less DC motor control.

TEXT BOOKS

1. John B. Peatman, 'Design with PIC Microcontrollers', Peasrson Education, Asia 2004.
2. Michael Khevi, 'The M68HC11 Microcontroller Applications in control, Instrumentation and communication', Prentice Hall, New Jersey, 1997.

REFERENCE

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

208PEPP01 – POWER ELECTRONICS AND DRIVES LABORATORY

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 AC voltage controller.
7. Simulation of closed loop control of converter fed DC motor drive.
8. Simulation of closed loop control of chopper fed DC motor drive.
9. Simulation of VSI fed three phase induction motor drive.
10. Simulation of three phase synchronous motor and drive.

308PEPE01 – COMPUTER COMMUNICATION AND NETWORKS

1. COMPUTER NETWORKS

Evolution of data networks, Network architecture, ISO Reference model examples of networks, Application of networks, Physical layer, and communication medium characteristics.

2. MEDIUM ACCESS SUB LAYER AND DATA LINK LAYER

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.

3. NETWORK AND TRANSPORT LAYERS

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.

4. QUEUING THEORY AND CAPACITY ASSIGNMENT

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 ad block storage.

5. PRESENTATION LAYER AND APPLICATION LAYER

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.

TEXT BOOKS

1. Andrew S. Tanenbaum, "Computer Networks", 4th Edition, Prentice Hall of India, 2003.
2. D.Bertsekas and R. Gallager, "Data networks", 2nd Edition, Prentice Hall of India, 2003.

REFERENCES

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

208PEPE02 – SOFTWARE ENGINEERING AND ARCHITECTURE

1. OVERVIEW OF SOFTWARE ENGINEERING

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.

2. REQUIREMENTS

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.

3. ARCHITECTURE AND SOFTWARE DESIGN

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.

4. CRITICAL SYSTEMS AND DEPENDABILITY

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.

5. SOFTWARE COST ESTIMATION

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.

TEXT BOOKsS

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

REFERENCES

1. Jawadekar, "Software Engineering", Tata McGraw-Hill, 2004.
2. Fairley, "Software Engineering Concepts", Tata McGraw Hill, 2004.

208PEPE05 – INTELLIGENT CONTROL

1. INTRODUCTION

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

2. ARTIFICIAL NEURAL NETWORKS

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.

3. GENETIC ALGORITHM

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.

4. FUZZY LOGIC SYSTEM

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.

5. APPLICATIONS

GA application to power system optimization 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.

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, uncertainly 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.

208PEPE03 – HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

1. DC POWER TRANSMISSION TECHNOLOGY

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

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

3. CONVERTER AND HVDC SYSTEM CONTROL

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

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

5. SIMULATION OF HVDC SYSTEMS

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

REFERENCES

1. Padiyar, K.R., "HVDC Power Transmission System", Wiley Eastern Limited, New Delhi 1990. First edition.
2. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, Extra high voltage AC transmission engineering New Age International (P) Ltd., New Delhi, 1990.
4. Arrillaga, J., High Voltage direct current transmission, Peter Pregrinus, London, 1983.

208PEPE06 – LINEAR AND NON-LINEAR SYSTEMS THEORY

1. PHYSICAL SYSTEMS AND STATE ASSIGNMENT

Systems: Electrical – Mechanical – Hydraulic – Pneumatic – Thermal systems – Modelling of some typical systems like DC Machines – Inverted Pendulum.

2. STATE SPACE ANALYSIS

Realisation of State models: - Non-uniqueness – Minimal realization – Balanced realization – Solution of state equations: - State transition matrix and its properties – Free and forced responses – Properties: Controllability and observability – Stabilisability and detectability – Kalman decomposition.

3. MIMO SYSTEMS-FREQUENCY DOMAIN DESCRIPTIONS

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.

4. NON-LINEAR SYSTEMS

Types of non-linearity – Typical examples – Equivalent linearization – Phase plane analysis – Limit cycles – Describing functions – Analysis using Describing functions – Jump resonance.

5. STABILITY

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.

REFERENCE BOOKS

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 Asia, Low priced Edition, 1997.
5. G.J.Thaler, "Automatic control systems", Jaico publishers, 1993.
6. John S. Bay, "Linear State Space Systems", McGrawHill International edition, 1999.

308PEPE07 – DIGITAL SIGNAL PROCESSING

1. DISCRETE TIME SIGNALS AND SYSTEMS

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.

2. FOURIER AND STRUCTURE REALIZATION

Discrete Fourier transform – properties – Fast Fourier transform – Z-transform – structure realization – Direct form – lattice structure for FIR filter – Lattice structure for IIR Filter.

3. FILTERS

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

4. MULTISTAGE REPRESENTATION

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.

5. DIGITAL SIGNAL PROCESSORS

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.

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1. John G.Proakis, Dimitris G.Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", PHI.
2. S.Salivahanan, A.Vallavaraj and C.Gnanapriya "Digital Signal Processing", TMH, 2000.
3. A.V. Oppenheim and R.W.Schafer, Englewood "Digital Signal Processing", Prentice Hall, Inc, 1975.
4. Rabiner and Gold, "Theory and Application of Digital Signal Processing", A comprehensive, Industrial – Strength DSP reference book.
5. B.Venkatramani & M.Bhaskar, "Digital Signal Processors architecture, Programming and Applications", TMH, 2002.

308PEPE04 – FLEXIBLE AC TRANSMISSION SYSTEMS

1. INTRODUCTION

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

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

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

4. DESIGN OF FACTS CONTROLLERS

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

5. STATIC VAR COMPENSATION

Basic concepts, Thyristor controlled reactor (TCR), Thyristors switched reactor (TSR), Thyristor switched capacitor (TSC), saturated reactor (SR), Fixed Capacitor (FC).

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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 High Power Engineering Review, 1998.
3. Narin G.Hingorani, "Power Electronics in Electric Utilities: Role of Power Electronics infuture 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.

Registrar