KUMARAGURU COLLEGE OF TECHNOLOGY, COIMBATORE-49
(An Autonomous Institution Affiliated to Anna University, Chennai)

CURRICULUM 2013

M.E - POWER ELECTRONICS AND DRIVES

SEMESTER – I

S. No	Code No	Course Title	L	T	P	C
Theory						
1.	P13MAT105	Applied Mathematics for Electrical Engineers	3	1	0	4
2.	P13PET101	Advanced Control Theory	3	1	0	4
3.	P13PET102	Advanced Power Semiconductor Devices	3	0	0	3
4.	P13PET103	Analysis of Power Converters	3	0	0	3
5.	P13PET104	Analysis of Inverters	3	0	0	3
6.	P13PETE**	Elective – I	3	0	0	3
Practical						
1.	P13PEP101	Power Electronics Simulation Laboratory I	0	0	3	1

TOTAL PERIODS – 23 **TOTAL CREDITS – 21**

SEMESTER – II

S. No	Code No	Course Title	L	T	P	C
Theory						
1.	P13PET201	Solid State DC Drives	3	0	0	3
2.	P13PET202	Solid State AC Drives	3	0	0	3
3.	P13PET203	Advanced Microprocessors and Microcontrollers	3	0	0	3
4.	P13PET204	Digital Control in Power Electronics	3	0	0	3
5.	P13PETE**	Elective – II	3	0	0	3
6.	P13PETE**	Elective – III	3	0	0	3
Practical						
1.	P13PEP201	Power Electronics and Drives Laboratory	0	0	3	1

TOTAL PERIODS – 21 **TOTAL CREDITS – 19**

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SEMESTER - III

S. No	Code No	Course Title	L	T	P	C
Theory						
1	P13PETE**	Elective – IV	3	0	0	3
2	P13PETE**	Elective – V	3	0	0	3
3	P13PETE**	Elective – VI	3	0	0	3
Practical						
1	P13PEP301	Advanced Power Electronics and Drives Laboratory	0	0	3	1
2	P13PEP302	Project – (Phase I)	0	0	12	6

TOTAL PERIODS – 24 **TOTAL CREDITS – 16**

SEMESTER - IV

S. No	Code No	Course Title	L	T	P	C
Practical						
1	P13PEP401	Project – (Phase II)	0	0	24	12

TOTAL PERIODS – 24 **TOTAL CREDITS – 12**

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LIST OF ELECTIVE

S. No	Code No	Course Title	L	T	P	C
1	P13PETE01	Intelligent Control	3	0	0	3
2	P13PETE02	Advanced Digital Signal Processing	3	0	0	3
3	P13PETE03	VHDL	3	0	0	3
4	P13PETE04	VLSI Design	3	0	0	3
5	P13PETE05	Special Electrical Machines	3	0	0	3
6	P13PETE06	Computer Communication and Networks	3	0	0	3
7	P13PETE07	Software Engineering and Architecture	3	0	0	3
8	P13PETE08	High Voltage Direct Current Transmission	3	0	0	3
9	P13PETE09	Flexible AC Transmission Systems	3	0	0	3
10	P13PETE10	Modeling and Analysis of Electrical Machines	3	0	0	3
11	P13PETE11	Advanced Embedded Systems	3	0	0	3
12	P13PETE12	Design of Embedded System	3	0	0	3
13	P13PETE13	Power Quality	3	0	0	3
14	P13PETE14	Switched Mode Power Conversion	3	0	0	3
15	P13PETE15	Multimedia Systems	3	0	0	3
16	P13PETE16	Operating Systems	3	0	0	3
17	P13PETE17	Robotics And Automation	3	0	0	3
18	P13PETE18	Renewable Energy Resources	3	0	0	3
19	P13PETE19	PWM Converters and Applications	3	0	0	3
20	P13MAE202	Operations Research	3	0	0	3

* - P13PETE01
** - P13PETE02
*** - P13PETE03
**** - **P13PETE04**

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P13MAT105	APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS	L T P C 3 1 0 4

On completion of the course, the students are expected

- To solve the Eigen value problems and find the inverse of a rectangular matrix.
- To find the curve on which functional can be extremised.
- To enhance the knowledge of Fourier analysis and Z-transforms.
- To acquire knowledge in wavelet transforms.
- To understand the soft computing techniques with their operations and functions.

UNIT I ADVANCED MATRIX THEORY 9

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

UNIT II CALCULUS OF VARIATIONS 9

Euler's equation – Functionals dependent on first and higher order derivatives – Functionals dependent on functions of several dependent variables – Some applications – Direct method : Ritz method.

UNIT III FOURIER ANALYSIS AND Z –TRANSFORMS 9

Discrete Fourier Transforms and its properties – Fourier series and its properties – Fourier representation of finite duration sequences – Z-transform – Properties of the region of convergence – Inverse Z-transform – Z-transform properties.

UNIT IV WAVELET TRANSFORMS 11

Continuous and discrete time wavelet transform – Definition and examples - Inverse transform of continuous and discrete time wavelet transform. Some applications.

UNIT V SOFT COMPUTING METHODS 9

Fuzzy variables - Fuzzy relations – Neural networks – Genetic algorithms (basic concepts only)

L+ T: 45+15 = 60

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TEXT BOOKS:

1. Lewis D.W., "Matrix Theory", Allied Publishers, Peebles Jr., P.Z., Chennai 1995.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 40th Edition 2007.
3. Raghuveer M . Rao, Ajit S. Bopardikar, " Wavelet Transforms introduction to theory and applications, Addition Wesley, 2003.
4. Rajasekaran S., Vijayalakshmi Pai G.A., "Neural Network, Fuzzy Logic and Genetic Algorithm", Synthesis and Applications, Prentice Hall of India – 2008.

REFERENCES:

1. Bronson R., "Theory and problems of Matrix operations", Schaums outline series, Tata McGraw Hill, New York, 2005.
2. Elsgolts L., "Differential equations and Calculus of variations", University Press of Pacific, 2006.
3. Athanasios Papoulis, "Probability, Random Variables and Stochastic Processes", McGraw Hill International Editions, 4th Edition 2002.
4. Sivanandam S. N., Deepa S.N., "Principles of Soft Computing", Wiley India Pvt. Limited, 2007.

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P13PET101	ADVANCED CONTROL THEORY	L	T	P	C
		3	1	0	4

OBJECTIVES

- To learn about the digital control systems and sampling.
- To study the state variable analysis
- To provide adequate knowledge in the state space analysis
- To study about the various nonlinearities like dead zone saturation and hysterisis
- To analyze the stability of the system using different techniques

UNIT – I INTRODUCTION TO DIGITAL CONTROL SYSTEMS 9

Configuration of the basic digital control scheme-Principles of signal conversion-Basic discrete time signals-Time domain models for discrete time systems-Transfer function models-Stability on the Z-plane and the Jury stability criterion-Sampling as impulse modulation-Sampled spectra and Aliasing-Filtering

UNIT – II STATE VARIABLE REPRESENTATION ANDSOLUTION OF STATE EQUATION 9

Introduction-State space formulation-state model of linear system-state diagram-state space representation using physical variable- state space representation using phase variable - state space representation using canonical variable-Solution of state equations-state space representation of discrete time systems.

UNIT – III STATE SPACE ANALYSIS AND DESIGN OF CONTROL SYSTEM 9

Definitions involving matrics-Eigen values and eigen vectors-Similarity transformation-Cayley-Hamilton theorem-Transformation of state model-Concepts of controllability and Obeservability-controllable phase variable form of state model-Control system design via pole place by state feedback –Observable phase variable form of state model-State observers.

UNIT – IV NON LINEAR SYSTEMS 9

Introduction to non linear systems-Describing functions-Deadzone, saturation non linearity, Dead zone and saturation non linearity, relay with dead zone and hysteresis, backlash nonlinearity-Describing function analysis of non linear systems.

UNIT – V LYAPUNOV STABILITY ANALYSIS 9

Introduction-Basic concepts-stability definitions-Stability Theorems- Lyapunov functions for linear systems-A model reference adaptive systems-Discrete time system

L: 45 T: 15 Total: 60 Hrs

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TEXT BOOKS:

1. M. Gopal, “Modern Control System Theory”, 3 rd editionNew Age International, 2005.
2. M.Gopal,”Digital control and state variable methods” 3 rd editionTata McGraw-Hill,1997

REFERENCES:

1. K. Ogata, “Modern Control Engineering”, 4 th edition PHI, 2002.
2. John S. Bay, “Fundamentals of Linear State Space Systems”, McGraw-Hill, 1999.
3. D. Roy Choudhury, “Modern Control Systems”, New Age International, 2005.
4. John J. D’Azzo, C. H. Houpis and S. N. Sheldon, “Linear Control System Analysis and Design with MATLAB”, Taylor Francis, 2003.
5. Z. Bubnicki, ”Modern Control Theory”, Springer, 2005.

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P13PET102	ADVANCED POWER SEMICONDUCTOR DEVICES	L	T	P	C
		3	0	0	3

UNIT I DEVICES AND CHARACTERISTICS 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 & Thyristor.

UNTI 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, optocopler – 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 hear sink selection – Thermal resistance and impedance - Electrical analogy of thermal components, heat sink types and design – Mounting types.

L: 45 Total: 45 Hrs

REFERENCES:

1. B.W Williams 'Power Electronics Circuit Devices and Applications' Mac, Million Pvt., Ltd.
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Third Edition, New Delhi, 2004.
3. MD Singh and K.B Khanchandani, "Power Electronics", Tata McGraw Hill, 2001.
4. Mohan, Undcland and Robins, "Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.

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P13PET103 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-E loads.

UNIT V CYCLOCONVERTERS 9

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

L: 45 Total: 45 Hrs

REFERENCES:

1. Ned Mohan, Undeland and Robbin, “Power Electronics: converters, 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.
3. P. C Sen.," Modern Power Electronics ", Wheeler publishing Co, First Edition, New Delhi-1998.
4. P. S. Bimbra, “Power Electronics”, Khanna Publishers, Eleventh Edition, 2003.

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P13PET104 **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 DC – link inverters.

L: 45 Total: 45 Hrs

REFERENCES:

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.
3. P.C. Sen, “Modern Power Electronics”, Wheeler Publishing Co, First Edition, New Delhi, 1998.
4. P. S. Bimbra, “Power Electronics”, Khanna Publishers, Eleventh Edition, 2003.
5. Bimal K. Bose “Modern Power Electronics and AC Drives”, Pearson Education, Second Edition, 2003.

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P13PEP101	POWER ELECTRONICS SIMULATION LABORATORY - I	L	T	P	C
		0	0	3	1

LIST OF EXPERIMENTS:

1. Simulation of single phase half controlled Converter.
2. Simulation of single phase fully controlled Converter.
3. Simulation of three phase half controlled Converter.
4. Simulation of three phase fully controlled Converter.
5. Simulation of DC chopper.
6. Simulation of single phase Inverter.
7. Simulation of three phase inverter.
8. Simulation of single phase AC voltage controller.
9. Simulation of three phase AC voltage controller.
10. Simulation of cyclo- converters.

P: 45 Total: 45 Hrs

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P13PET201 **SOLID STATE DC DRIVES**

L	T	P	C
3	0	0	3

UNIT I DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS 9

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.

UNIT II CONVERTER CONTROL \9

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

UNIT V DIGITAL CONTROL OF DC DRIVE 9

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

L: 45 Total: 45 Hrs

Signature of the Chairman BOS EEE

REFERENCES:

1. Gopal K Dubey, “Power Semiconductor controlled Drives”, Prentice Hall Inc., New Jersy, 1989.
2. R. Krishnan, “ Electric Motor Drives – Modeling, Analysis and Control”, Prentice- Hall of India Pvt. Ltd., New Delhi, 2003.
3. Gobal K. Dubey, “Fundamentals of Electrical Drives”, Narosal Publishing House, New Delhi, 2001.
4. Bimal K. Bose “Modern Power Electronics and AC Drives”, Pearson Education, (Singapore) Pvt. Ltd., New Delhi, 2003.
5. Vedam Subramanyam, “Electric Drives – Concepts and Applications”, Tata McGraw-Hill publishing company Ltd., New Delhi, 2002.
6. P.C Sen “Thyristor DC Drives”, John Wiely and sons, New York, 1981.

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P13PET202 **SOLID STATE AC 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

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.

UNIT III FIELD ORIENTED CONTROL 9

Field oriented control of induction machines – Theory – DC 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.

L: 45 Total: 45 Hrs

REFERENCES:

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.
3. W. Leonhard, “Control of Electrical Drives”, Narosa Publishing House, 1992.
4. Murphy J.M.D and Turnbull, “Thyristor Control of AC Motors”, Pergamon Press, Oxford, 1988.

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P13PET203 ADVANCED MICROPROCESSORS AND MICRO CONTROLLERS

L	T	P	C
3	0	0	3

UNIT I MICROPROCESSOR ARCHITECTURE 9

Instruction set – Data formats – Instruction formats – Addressing modes – Memory Hierarchy – register file – Cache – Virtual memory and paging – Segmentation – Pipelining – The instruction pipeline – pipeline hazards – Instruction level parallelism – reduced instruction set – Computer principles – RISC versus CISC – RISC properties – RISC evaluation – On-chip register files versus cache evaluation.

UNIT II HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM 9

The software model – functional description – CPU pin descriptions – RISC concepts – bus operations – Super scalar architecture – pipe lining – Branch prediction – The instruction and caches – Floating point unit – protected mode operation – Segmentation – 1paging – Protection – multitasking – Exception and interrupts – Input/Output – Virtual 8086 model – Interrupt processing – Instruction types – Addressing modes – Processor flags – Instruction set – Basic programming the Pentium Processor.

UNIT III HIGH PERFORMANCE RISC ARCHITECTURE: ARM 9

The ARM architecture – ARM organization and implementation – The ARM instruction set – The thumb instruction set – Basic ARM Assembly language program – ARM CPU Cores.

UNIT IV MOTOROLA 68HC11 MICRO CONTROLLERS 9

Instructions and addressing modes – operating modes – Hardware reset – Interrupt system – Parallel I/O ports – Flats – Real time clock – Programmable timer – pulse accumulator – serial communication interface – A/D converter – hardware expansion – Basic Assembly Language programming.

UNIT V PIC MICRO CONTROLLER 9

CPU Architecture – Instruction set – Interrupts – Timers – Memory – I/O port expansion – I2C bus for peripheral chip access – A/D converter – UART.

L: 45 Total: 45 Hrs

REFERENCES:

1. Daniel Tabak, “Advanced Microprocessors” McGraw Hill. Inc., 1995.
2. James L. Antonakos , “The Pentium Microprocessor” Pearson Education, 1997.
3. Steave Furber, “ARM system – on – chip architecture” Addison Wesley, 2000.
4. Gene. H.Miller, “Micro Computer Engineering”, Pearson Education, 2003.
5. John.B. Peatman, “Design with PIC Micro controller”, Pearson Education, 1988.
6. James L Antonakos, “An Introduction to the Intel family of Microprocessors” Pearson Education, 1999.
7. Barry B.Breg, “The Intel Microprocessors Architecture, Programming and Interfacing” PHI, 2002.

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P13PET204	DIGITAL CONTROL IN POWER ELECTRONICS	L	T	P	C
		3	0	0	3

UNIT I MATHEMATICAL MODELING OF DIGITAL POWER ELECTRONICS 9

Introduction – A zero-order hold (ZOH) for AC/DC controlled rectifiers – A first-order transfer function for DC/AC pulse-width-modulation inverters – A second-order transfer function for DC/DC converters – A first-order transfer function for AC/AC (AC/DC/AC) converters – Open-loop Control for Digital Power Electronics – Stability analysis – Unit-step function response – Impulse responses.

UNIT II DIGITALLY CONTROLLED AC/DC RECTIFIERS 9

Introduction – Mathematical modeling for AC/DC rectifiers – Single-phase half-wave controlled AC/DC rectifier - Single-phase full-wave AC/DC rectifier - Three-phase half-wave controlled AC/DC rectifier - Three-phase full-wave controlled AC/DC rectifier – Three-phase double-anti-star with interphase-transformer controlled AC/DC rectifier – Six-phase half-wave controlled AC/DC rectifier - Six-phase full-wave controlled AC/DC rectifier

UNIT III DIGITALLY CONTROLLED DC/AC INVERTERS 9

Introduction – Mathematical modeling for DC/AC PWM inverters – Single-phase half-wave VSI – Single-phase full-bridge PWM VSI - Three-phase full-bridge PWM VSI - Three-phase full-bridge PWM CSI – Multistage PWM inverter – Multilevel PWM inverter.

UNIT IV DIGITALLY CONTROLLED DC/DC CONVERTERS 9

Introduction – Mathematical modeling for power DC/DC converters – Fundamental DC/DC converter – Developed DC/DC converters – Soft-switching converters – Multi-element resonant power converters.

UNIT V DIGITALLY CONTROLLED AC/AC CONVERTERS 9

Introduction – Traditional modeling for AC/AC (AC/DC/AC) converters – Single-phase AC/AC converter – Three-phase AC/AC voltage controllers – SISO cyclo converters – TISO cyclo converters – TITO cyclo converters – AC/DC/AC PWM converters – Matrix converters.

L: 45 Total: 45 Hrs

REFERENCES:

1. Fang Lin Luo, Hong Ye, Muhammad Rashid " Digital Power Electronics and Applications" ELSEVIER Academic Press.

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L	T	P	C
0	0	3	1

P13PEP201 POWER ELECTRONICS AND DRIVES LABORATORY

LIST OF EXPERIMENTS:

1. Single phase half controlled Converter with RL and RLE loads.
2. Single phase fully controlled Converter with RL and RLE loads.
3. Three phase fully controlled Converter fed DC Shunt motor.
4. Four quadrant IGBT based chopper fed DC motor drive
5. Single phase PWM inverter
6. Three phase PWM inverter fed Induction motor Drive.
7. Resonant converters.
8. Series Inverter.
9. AC voltage controller.
10. BLDC motor drive.

P: 45 Total: 45 Hrs

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P13PEP301	ADVANCED POWER ELECTRONICS AND DRIVES LABORATORY	L	T	P	C
		0	0	3	1

LIST OF EXPERIMENTS:

1. Simulation of closed loop control of Converter fed DC motor.
2. Simulation of closed loop control of Chopper fed DC motor.
3. Simulation of closed loop control of VSI fed three-phase induction motor.
4. Simulation of closed loop control of Synchronous motors.
5. Simulation of Four quadrant operation of three-phase induction motor.
6. DSP based speed control of SRM motor.
7. Realization of control logic for electric motors using FPGA.
8. Design of switched mode power supplies
9. Design of Buck boost converters
10. Harmonic Analysis of power converters

P: 45 Total: 45 Hrs

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P13PETE01 / P13ESTE01 INTELLIGENT CONTROL

L	T	P	C
3	0	0	3

UNIT I SYSTEMS AND APPROACHE 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 FL AND NN 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.

L: 45 Total: 45 Hrs

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.

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P13PETE02 / P13ESTE02 ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

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 a n 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.

L: 45 Total: 45 Hrs

REFERENCES:

1. John G.Proakis, Dimitris G.Manolakis, “Digital Signal Processing: Principles, Algorithms and Applications”, PHI 1997 Edition 3.
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”, rentice- Hall, Inc, 1975.
4. Rabiner and Gold, “Theory and Application of Digital Signal Processing”, A comprehensive, Industrial – Strength DSP reference book 1998 PHI
5. B.Venkatramani & M.Bhaskar, “Digital Signal Processors architecture, Programming and Applications”, TMH, 2002.

Signature of the Chairman BOS EEE

P13PETE03 / P13ESTE03	VHDL	L	T	P	C
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UNIT I VHDL FUNDAMENTALS 9

Fundamental Concepts – Modeling Digital Systems – Domains and Levels of Modeling – Modeling Languages – VHDL Modeling concepts – Scalar Data Types and Operations– Constants and variables – Scalar Types – Type Classification – Attributes and Scalar types – Expressions and operators – Sequential Statements – If statements – Case statements – Null Statements – Loop statements – Assertion and Report statements.

UNIT II COMPOSITE DATA TYPES AND BASIC MODELING CONSTRUCTS 9

Arrays – Unconstrained Array types – Array Operations and Referencing – Records – Basic Modeling Constructs – Entity Declarations – Architecture Bodies – Behavioral Descriptions – Structural Descriptions – Design Processing. Case Study: A pipelined Multiplier Accumulator.

UNIT III SUBPROGRAMS AND PACKAGES 9

Procedures – Procedure Parameters – Concurrent Procedure Call Statements – functions – Overloading – Visibility of Declarations – Packages and Use Clauses – Package declarations – Package bodies – Use Clauses – The predefined – Aliases - Aliases for data objects – Aliases for Non-Data Items. Case Study: A Bit-Vector Arithmetic Package.

UNIT IV SIGNALS, COMPONENTS, CONFIGURATIONS 9

Basic Resolved signals – IEEE Std_Logic_1164 Resolved subtypes – Resolved signal parameters – Generic Constants – Parameterizing behavior – Parameterizing structure – Components and Configurations – Components – Configuring component Instances – Configuration Specification – Generate Statements – generating iterative structure – Conditionally generating structures – Configuration of generate Statements. Case Study: The DLX Computer System.

UNIT V ADTs AND FILES 9

Access Types – Linked Data structures – Abstract Data Types using Packages – Files and Input/Output – Files – The Package Textio – Verilog. Case Study: Queuing Networks.

L: 45 Total: 45 Hrs

REFERENCES:

1. Peter J.Ashenden, The Designer's Guide to VHDL, Morgan Kaufmann Publishers, San Francisco, Second Edition, May 2001.
2. Zainalabedin Navabi, VHDL Analysis and Modeling of Digital Systems, McGraw Hill International Editions, Second Edition, 1998.
3. James M.Lee, Verilog Quick start, Kluwer Academic Publishers, Second Edition, 1999.

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P13PETE04 / P13ESTE04 VLSI DESIGN

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UNIT I VLSI DESIGN METHODOLOGY & MOS TECHNOLOGY 9

VLSI Design process — Architectural Design — Logical design — Physical design — Layout styles — Full custom — Semicustom approaches - An overview of wafer fabrication — Wafer processing — Oxidation — Patterning — Diffusion — Ion implantation — Deposition — Silicon gate nMOS process — CMOS processes — nWeIl — pWell — Twintub — Silicon on insulator.

UNIT II ELECTRICAL PROPERTIES OF MOS AND CMOS CIRUITS 9

MOS enhancement transistor — PMOS enhancement transistor — Threshold voltage — Threshold voltage equations — MOS device equations — Basic DC equations — Second order effects — MOS modules — Small signal AC characteristics — nMOS inverter— Steered Input to an nMOS inverter — Depletion mode and enhancement mode pullups — CMOS inverter — DC characteristics — Inverter delay — Pass transistor — Transmission gate.

UNIT III MOS AND CMOS CIRCUIT DESIGN PROCESSES 9

CMOS process enhancements — Interconnect - Circuit elements - Latchup – Latchup prevention techniques - Need for Layout design rules — Mead conway design rules for the silicon gate nMOS process — CMOS nWelllpWell design rules — Simple Layout examples — Sheet resistance — Area capacitance — Wiring Capacitance — Drive large capacitive loads.

UNIT IV LOGIC DESIGN 9

Switch Logic — Pass Transistor and transmission gate — Gate Logic — Iriverter — Two input NAND gate — NOR gate — Other forms of CMOS logic — Dynamic CMOS logic — Clocked CMOS logic — Precharged domino CMOS logic — Structured design — Simple combinational logic design examples — Parity generator — Multipiexers — Clocked sequential circuits —Two phase clocking — Charge storage — Dynamic register element — nMOS and CMOS — Dyrimic shift register — Semi static register — JK flip flop circuit.

UNIT V TESTING 9

Importance of testing – Boundary – Scan Test – fauits – fault simulation – Automatic Test – Pattern Generation – IDDQ Test – Built – in Self Test – A simple test example..

L: 45 Total: 45 Hrs

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REFERENCES:

1. Douglas A Pucknell and Kamran Eshrarigian, 'Basic VLSI Design; Prentice Hall of India, New Delhi, Ill Edition, 1999.
2. Neil H B West and Kamran Eshranghian, 'Principles of CMOS VLSI Design: A system perspective Addison-Wesley, II Edition, II Indian Reprint, 2000.
3. Amar Mukherjee, 'Introduction to nMOS and CMOS VLSI system design: Prentice Hail, USA, 1996.
4. Wayne Wolf, 'Modem VLSI Design: Systems on Si1icon II Edition, Pearson Education, III Indian Reprint, 2001.
5. Eugene D Fabricous, 'Introduction to VLSI design: McGraw Hill International Edition, 1990.

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P13PETE05 SPECIAL ELECTRICAL MACHINES

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UNIT I SYNCHRONOUS RELUCTANCE MOTORS 9

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

UNIT II SWITCHED RELUCTANCE MOTORS 9

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

UNIT III PERMANENT MAGNET SYNCHRONOUS MOTORS 9

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

UNIT IV PERMANENT MAGNET BRUSHLESS DC MOTORS 9

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

UNIT V STEPPING MOTORS 9

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

L: 45 Total: 45 Hrs

REFERENCES:

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.
3. Kenjo, T and Naganori, S “Permanent Magnet and brushless DC motors ", Clarendon Press, Oxford, 1989.
4. Kenjo, T. Power Electronics for the microprocessor Age, 1989.
5. B.K. Bose, “Modern Power Electronics & AC drives” Pearson Education Asia, 2002
6. R.Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice- Hall of India Pvt. Ltd., New Delhi, 2003.

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P13PETE06	COMPUTER COMMUNICATION AND NETWORKS	L	T	P	C
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UNIT I COMPUTER NETWORKS 9

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

UNIT II MEDIUM ACCESS SUB LAYER AND DATA LINK LAYER 9

Local area networks, conventional channel allocation methods, pure-ALOHA, SALOHA, 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 ad 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.

L: 45 Total: 45 Hrs

REFERENCES:

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

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P13PETE07	SOFTWARE ENGINEERING AND ARCHITECTURE	L	T	P	C
		3	0	0	3

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.

L: 45 Total: 45 Hrs

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REFERENCES:

1. Ian Sommerville, “Software Engineering”, Sixth Edition, Pearson Education, 2001.
2. Jawadekar, “Software Engineering”, Tata McGraw-Hill, 2004.
3. Fairley, “Software Engineering Concepts”, Tata McGraw Hill, 2004.

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P13PETE08	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	L	T	P	C
		3	0	0	3

UNIT I 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.

UNIT II ANALYSIS OF HVDC CONVERTERS 9

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

UNIT III 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.

UNIT IV HARMONICS AND FILTERS 9

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

UNIT V SIMULATION OF HVDC SYSTEMS 9

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

L: 45 Total: 45 Hrs

REFERENCES:

1. Padiyar, K.R., "HVDC Power Transmission System", Wiley Eastern Limited, New Delhi 1990. First edition.
2. Rakosh Das Begamudre, Extra high voltage AC transmission engineering New Age International (P) Ltd., New Delhi, 1990.
3. Arrillaga, J., High Voltage direct current transmission, Peter Pregrinus, London, 1983.

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P13PETE09 FLEXIBLE AC TRANSMISSION SYSTEMS

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3	0	0	3

UNIT I FACTS APPLICATIONS 9

Introduction – Power flow control-Stability constraint of maximum transmission line loading- Reactive power constraint of maximum transmission line loading- Uncompensated line- Passive compensation.

UNIT II SERIES COMPENSATORS 9

Objectives – Variable Impedance type series compensation – TCSC – TSSC switching converter type series compensators – SSSC

UNIT III SHUNT COMPENSATORS 9

Objectives of shunt compensation – Methods of controllable VAR generation – SVC and STATCOM – saturated Reactor – TCR – TSC – FCTCR

UNIT IV EMERGING FACTS CONTROLLERS 9

UPFC – Basic operating principles – Conventional Transmission Control capabilities – The Interline Power flow controller (IPFC) – Operating Principles - Control Structure

UNIT V SPECIAL PURPOSE FACTS CONTROLLERS 9

Sub - Synchronous Resonance – NGH SSR damping scheme – TCBR – Thyristor Controlled voltage limiter – Thyristor Controlled Voltage Regulator – Thyristor Controlled Current Limiter

L: 45 Total: 45 Hrs

REFERENCES:

1. N. G. Hingorani, L. Gyugi, " Understanding FACTS - Concept and technology of FACTS", IEEE press books Standard Publishers distributors, Delhi 2001.
2. Mohan Mathur. R., Rajiv K. Varma, "Thyristor – Based FACTS Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc 1994.

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P13PETE10	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 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

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 emf type) and interior permanent magnet machines. Construction and operating principle, dynamic modeling and self controlled operation; Analysis of Switch Reluctance Motors

L: 45 Total: 45 Hrs

REFERENCES:

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

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P13PETE11 ADVANCED EMBEDDED SYSTEMS

L	T	P	C
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UNIT I INTRODUCTION AND REVIEW OF EMBEDDED HARDWARE 9

Terminology – Gates – Timing diagram – Memory – Microprocessor buses – Direct memory access – Interrupts – Built interrupts – Interrupts basis – Shared data problems – Interrupt latency - Embedded system evolution trends – Round-Robin – Round Robin with interrupt function – Rescheduling architecture – algorithm.

UNIT II REAL TIME OPERATING SYSTEM 9

Task and Task states – Task and data – Semaphore and shared data operating system services – Message queues timing functions – Events – Memory management – Interrupt routines in an RTOS environment – Basic design using RTOS.

UNIT III EMBEDDED HARDWARE, SOFTWARE AND PERIPHERALS 9

Custom single purpose processors: Hardware – Combination Sequence – Processor design – RT level design – optimising software: Basic Architecture – Operation – Programmers view – Development Environment – ASIP – Processor Design – Peripherals – Timers, counters and watch dog timers – UART – Pulse width modulator – LCD controllers – Key pad controllers – Stepper motor controllers – A/D converters – Real time clock.

UNIT IV MEMORY AND INTERFACING 9

Memory: Memory write ability and storage performance – Memory types – composing memory – Advance RAM interfacing communication basic – Microprocessor interfacing I/O addressing – Interrupts – Direct memory access – Arbitration multilevel bus architecture – Serial protocol – Parallel protocols – Wireless protocols – Digital camera example.

UNIT V CONCURRENT PROCESS MODELS AND HARDWARE SOFTWARE CO- DESIGN 9

Modes of operation – Finite state machines – Models – HCFSL and state charts language – state machine models – Concurrent process model – Concurrent process – Communication among process –Synchronization among process – Implementation – Data Flow model. Design technology; Automation synthesis – Hardware software cosimulation – IP cores – Design Process Model.

L: 45 Total: 45 Hrs

REFERENCES:

1. David. E.Simon "An Embedded Software Primer", Pearson Education, 2001.
2. Frank Vahid and Tony Gwargie "Embedded System Design", John Wiley & sons, 2002.
3. Steve Heath, "Embedded System Design", Elserien, Second Edition, 2004.

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P13PETE12 DESIGN OF EMBEDDED SYSTEMS

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UNIT I EMBEDDED DESIGN LIFE CYCLE 9

Product Specification – Hardware / software Partitioning – Detailed Hardware and Software Design – Integration – Product Testing – Selection Processes – Microprocessor Vs Microcontroller – Performance Tools – Bench Marking – RTOS Micro Controller – Performance Tools – Bench Marking – RTOS Availability – Tool Chain Availability – Other Issues in Selection Processes.

UNIT II PARTITIONING DECISION 9

Hardware / Software Duality – Coding Hardware – ASIC Revolution – Managing the risk – Co – Verification – Execution Environment - - Memory Organization – System Startup – Hardware Manipulation – Memory – Mapped Access – Speed and Code Density.

UNIT III INTERRUPT SERVICE ROUTINES 9

Watch Dog timers – Flash Memory Basic Toolset – Host Based Debugging – Remote Debugging – ROM Emulators – Logic Analyzer – Caches – Computer Optimisation – Statistical Profiling.

UNIT IV IN CIRCUIT EMULATORS 9

Bullet Proof Run Control – Real Time Trace – Hardware Break Points – Overlay Memory – Timing Constraints – Usage Issues – Triggers.

UNIT V TESTING 9

Bug Tracking – Reduction of Risks and Costs – Performance – Unit Testing – Regression Testing – Choosing Test Cases – Functional Tests – Coverage Tests – Testing Embedded Software Performance Testing – Maintenance.

L: 45 Total: 45 Hrs

REFERENCES:

1. Arnold S. Berger, “Embedded System Design”, CMP Books, USA, 2002
2. Steve Heath, “Embedded System Design”, Newnes Publication, Second Edition, 2003
3. Peter Marweded, “Embedded System Design”, Kluwer Academic Publishers, 2003

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P13PETE13 **POWER QUALITY**

L	T	P	C
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UNIT I INTRODUCTION TO POWER QUALITY 3

Terms and definitions: Overloading, under voltage, sustained interruption; sags and swells; waveform distortion, Total Harmonic Distortion (THD), Computer Business Equipment Manufacturers Associations (CBEMA) curve.

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 7

Sources of sags and interruptions, estimating voltage sag performance, motor starting sags, estimating the sag severity, mitigation of voltage sags, active series compensators, static transfer switches and fast transfer switches.

UNIT III OVERVOLTAGES 10

Sources of over voltages: Capacitor switching, lightning, ferro resonance; mitigation of voltage swells: Surge arresters, low pass filters, power conditioners – Lightning protection, shielding, line arresters, protection of transformers and cables, computer analysis tools for transients, PSCAD and EMTP.

UNIT IV HARMONICS 12

Harmonic distortion: Voltage and current distortion, harmonic indices, harmonic sources from commercial and industrial loads, locating harmonic sources; power system response characteristics, resonance, harmonic distortion evaluation, devices for controlling harmonic distortion, passive filters, active filters, IEEE and IEC standards.

UNIT V POWER QUALITY MONITORING 13

Monitoring considerations: Power line disturbance analyzer, per quality measurement equipment, harmonic / spectrum analyzer, flicker meters, disturbance analyzer, applications of expert system for power quality monitoring.

L: 45 Total: 45 Hrs

REFERENCES:

1. Roger.C.Dugan, Mark.F.McGranagham, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality' McGraw Hill, 2003.
2. Math H J Bollen ' Understanding Power Quality Problem' IEEE – Willley , IEEE Press , October 1999
3. C. Sankaran " Power Quality', CRC press 2002
4. Alexander Kusko ' Power Quality in Elctrical System' CHIPS Press, Texas 2007
5. PSCAD User Manual.

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P13PETE14 SWITCHED MODE POWER CONVERSION

L	T	P	C
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UNIT I DEIGN OF L & C ELEMENTS 9

Reactive Elements in Power Electronic Systems, Design of Inductor, Design of Transformer, Capacitors for Power Electronic Applications.

UNIT II SWITCHED MODE POWER CONVERTERS 9

Basic concepts of Switched Mode Power Converters, DC – DC Converters Characteristics, Constituent Elements, Operating Principles.

UNIT III DYNAMIC ELEMENTS 9

Steady State Analysis, Stress and Sizing of Elements, Control Methods, Duty Ratio, Current Programmed, Frequency Programmed and Sliding Mode Control, Dynamic Analysis and Frequency Domain Models.

UNIT IV RESONANT CONVERTERS 9

Classification of Resonant Converters, Basic Resonant Circuit Concepts, Load Resonant Converters, Resonant Switch Converters, Zero Voltage Switching.

UNIT V APPLICATIONS 9

Design of Feed Back Compensators, Unity Power Factor Rectifiers, Resistor Emulation Principle and Applications to Rectifiers.

L: 45 Total: 45 Hrs

REFERENCES:

1. "Switched Mode Power Conversion", Course Notes, CCE, IISc, 2004
2. Issa Batarseh, "Power Electronic Circuits", John Wiley, 2004\
3. Philip T Krein, "Elements of Power Electronics", Oxford Press, 1997

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P13PETE15 **MULTIMEDIA SYSTEMS**

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UNIT I MULTIMEDIA 9

Introduction – Multimedia modalities, Channels and Medium – Interaction – Communicative Interaction – Objects and Agents – Channels of Communication – Artificial Languages – Natural Communication – Meta-languages – Components of Interactive Multimedia Systems.

UNIT II KNOWLEDGE AND USER UNDERSTANDING 9

Knowledge – Basic idea of knowledge – A working definition – Knowledge representation – Knowledge Elicitation – Know about user applying user knowledge – acquiring user knowledge – User profiling – User modelling.

UNIT III INTERACTION, INTERFACE & SEMIOTICS 9

Traditional HCI – Modalities and the interface – Interface channels – Functionality and usability – Visual appearance and Graphic design – Multimedia content – Semiotics – Idea of a Sign – Comples Signs – Semiotics and Media.

UNIT IV TEXT AND SOUND 9

Visual Perception of Text – Images on Page – Meaning and Text Readability – Text and the Screen – Modality of Sound – Channels of Communication – Combining Sound Chanles – Technology of Sound – MIDI.

UNIT V IMAGES 9

Psychology of vision – Representational Images – Juxtaposition of Images – Perception of Motion – Constructing a Shot – Shots into narrative – Modern languages of film and television.

L: 45 Total: 45 Hrs

REFERENCES:

1. Mark Elsom-Cook, "Principles of Interactive Multimedia" McGraw Hill, International Edition 2001.
2. Ralf Steinmetz, "Multimedia Systems", Springer, 2004
3. John F. Koegel Buford, "Multimedia Systems", Addison – Wesley, 1994

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P13PETE16	OPERATING SYSTEMS	L	T	P	C
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UNIT I OPERATING SYSTEM 9

Operating systems and services – Processes – CPU Scheduling approaches.

UNIT II PROCESS SYNCHRONIZATION 9

Semaphores – Deadlocks – Handling deadlocks – ultithreading.

UNIT III MEMORY MANAGEMENT 9

Paging – Segmentation – Virtual memory – Demand paging – Replacement algorithms.

UNIT IV DISK SCHEDULING APPROACHES 9

File systems – Design issues – User interfaces to file systems – I / O device management.

UNIT V CASE STUDY 9

Design and implementation of the UNIX OS, process model and Structure – Memory management – File system – UNIX I / O management and Device drivers – Windows – System components – Process management – Memory management – File systems – Networking.

L: 45 Total: 45 Hrs

REFERENCES:

1. Abraham Silberschatz Peter B. Galvin, G.Gagne, "Operating System Concepts", 6th Edition, Wesley Publishing company, 2003.

2. M.J.Bach, Design of the UNIX Operating System, Prentice Hall, 1986.

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P13PETE17	ROBOTICS AND AUTOMATION	L	T	P	C
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UNIT I BASICS OF ROBOTICS 8

Geometric configuration of robots – Manipulators – Drive systems – Internal and external sensors – End effectors – Control systems – Robot programming languages and applications – Introduction to robotic vision.

UNIT II ROBOT ARM KINEMATICS 9

Direct and inverse kinematics – Rotation matrices – Composite rotation matrices – Euler angle representation – Homogenous transformation – Denavit Hattenberg representation and various arm configuration.

UNIT III ROBOT ARM DYNAMICS 9

Lagrange – Euler formulation, joint velocities – Kinetic energy – Potential energy and motion equations – Generalised D'Alembert equations of motion.

UNIT IV PLANNING OF MANIPULATOR TRAJECTOR 9

General consideration on trajectory planning joint interpolation & Cartesian path trajectories.

UNIT V CONTROL OF ROBOT MANIPULATORS 10

PID control computed, torque technique – Near minimum time control – Variable structure control – Non-linear decoupled feedback control – Resolved motion control and adaptive control.

L: 45 Total: 45 Hrs

REFERENCES:

1. Fu, K.S. Gonazlez, R.C. and Lee, C.S.G., "Robotics (Control, Sensing, Vision and Intelligence), McGraw-Hill, 1968 (II printing).
2. Wesley, E. Sryda, "Industrial Robots: Computer interfacing and Control" PHI, 1985.
3. Asada and Slotine, "Robot Analysis and Control", John Wiley and Sons, 1986.
4. Philippe Coiffet, "Robot Technology" Vol. II (Modelling and Control), Prentice Hall INC, 1981.
5. Saeed B. Niku, "Introduction to Robotics, Analysis, systems and Applications", Pearson Education, 2002
6. Groover M. P. Mitchell Wesis., "Industrial Robotics Technology Programming and Applications", Tata McGraw-Hill, 1986.

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P13PETE18 RENEWABLE ENERGY RESOURCES

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UNIT I PRINCIPLES OF RENEWABLE ENERGY 9

Introduction – Energy and Sustainable development – Fundamentals – Scientific principles of renewable energy – Technical implications – Social implications.

UNIT II SOLAR ENERGY 9

Solar radiation, its measurements and prediction. Solar thermal connectors – flat plate collectors – concentrating collectors – Theory of flat plate collectors – advanced collectors – optical design of concentrators – selective coatings. Solar Photovoltaics - Principle of photovoltaic conversion of solar energy – types of SPV cells and fabrication.

UNIT III WIND ENERGY 9

Wind Energy – atmospheric circulations – classification – factors influencing wind – wind shear – turbulence – wind speed monitoring – wind regime analysis using weibull parameters – power in the wind – Betz limit – wind resource assessment – siting and micrositing.

UNIT IV OCEAN ENERGY 9

Ocean energy resources – Ocean energy routes – Principles of ocean thermal energy conversion systems – ocean thermal power plants. Principles of Ocean wave energy conversion and tidal energy conversion.

UNIT V ALTERNATE SOURCES 9

Hydropower – nuclear fusion – Hydrogen as a source of energy – Magnetohy drodynamic Energy conversion.

L: 45 Total: 45 Hrs

REFERENCES:

1. G. D. Rai, Non Conventional Energy Sources – Khanna Publication, 1998
2. S. P. Sukhatme – Solar Energy; Principles of Thermal Collection and Storage, Tata McGraw- Hill (1984).
3. Nonconventional Energy Resources – B. H. Khan, TMH Publication, 2007.
4. Renewable Energy, Bent Sorensen (2nd Ed), Academic Press, New York, 2000

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5. Renewable Energy; Power for a sustainable future, (Ed) Godfrey Boyle, Oxford, OUP, 1996

6. Renewable Energy: Sources for fuels and electricity, (Ed). Thomas B. Johanson (et. Al.,) Earthscan Publishers,London 1993.

7. Anthony San Pietro, Biochemical and photosynthetic aspects of Energy Production, Academic Press, new York, 1980.

8. R.C. Maheswari, Bio Energy for Rural Energisation, Concepts Publication, 1997

9. Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986.

10. GeoTechnical Engineering Edition II, Venkatramaiah (C) New Age International (P) Ltd, 1995

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P13PETE19 PWM CONVERTERS AND APPLICATIONS

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UNIT I POWER CONVERTERS 9

AC/DC and DC/AC power conversion, overview of applications of voltage source converters, pulse modulation techniques for bridge converters.

UNIT II PWM TECHNIQUES 9

Bus clamping PWM, space vector based PWM, advanced PWM techniques, practical devices in converter; calculation of switching and conduction losses.

UNIT III DYNAMIC MODELING 9

Compensation for dead time and DC voltage regulation; dynamic model of a PWM converter, multilevel converters; constant V/F induction motor drives.

UNIT IV POWER FACTOR CORRECTION 9

Estimation of current ripple and torque ripple in inverter fed drives; line – side converters with power factor compensation.

UNIT V POWER QUALITY IMPROVEMENT 9

Active power filtering, reactive power compensation; harmonic current compensation.

L: 45 Total: 45 Hrs

REFERENCES:

1. Mohan, undeland and Robbins, 'Power Electronics; Converters, Applications and Design', John Wiley and Sons, 2nd Edition, 1995

2. Erickson R W, ' Fundamentals of Power Electronics', Chapman and Hall, 2001.

3. Vithyathil J, 'Power Electronics: Principles and Applications', McGraw Hill, 1995.

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UNIT I INTRODUCTION TO LINEAR PROGRAMMING (LP) 9

Formulation of LP, Graphical method, Simplex Algorithm, Assignment model, Transportation model.

UNIT II ADVANCED TOPICS IN LINEAR PROGRAMMING 9

Revised simplex method, Duality in Simplex, Sensitivity analysis, Introduction to Integer Programming – Cutting plane algorithm – Branch and Bound technique.

UNIT III NET WORK ANALYSIS \9

Maximum flow, shortest route, spanning tree problems, Scheduling computations, PERT, CPM.

UNIT IV REPLACEMENT MODELS & ADVANCED TOPICS IN NET WORK ANALYSIS 9

PERT Cost, Resource smoothening, Resource scheduling, Updating of networks. Replacement policy for items that deteriorate with time - ignoring time value of money - considering time value of money, Replacement policies (individual and group) for items that fail suddenly.

UNIT V WAITING LINE MODELS AND SEQUENCING 9

Queuing characteristics and terminology, single server and parallel server models. Sequencing, n-jobs x 2-machines, n-jobs x 3-machines, 2-jobs through m- machines, Travelling salesman problem

L: 45 Total: 45 Hrs

REFERENCES:

1. Hamdy A.Taha, "Operations Research: an introduction", 4th edition, Mc Millan Co., 2003.
2. Don T.Phillips, A.Ravindran & James Solberg, Operations Research: Principles and practice, John Wiley & Sons, 1992.
3. Guisseppi A.Forgionne, Quantitative decision making, Wordsworth Publishing Co., 1986.
4. Schaum's Outline Series Operations Research II Edition, Richard Broson, Govindasamy Naachimuthu, 2000.
5. Hillier and Lieberman, " Introduction to Operations Research", McGraw Hill International Edition, Seventh Edition, 2001.
6. Bhaskar.S, "Operations Research", 2nd edition, Anuradha publishers, 2004.

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