M.TECH. POWER ELECTRONICS & ELECTRICAL DRIVES SYLLABUS SESSION 2013-14

SUBJECT/ SEMESTER	Teaching Hrs/week		Examination Scheme		
	L	T/P	Max. Marks		Total Marks
			Theory	Sessional	
FIRST SEMESTER					
1MPD1 : ADVANCED POWER SEMICONDUCTOR DEVICES	3	1	100	25	125
1MPD 2 : ADVANCED POWER ELECTRONICS	3	1	100	25	125
1MPD 3: ELECTRICAL MACHINE MODELING AND ANALYSIS	3	1	100	25	125
1MPD 4: MODERN CONTROL SYSTEM	3	1	100	25	125
1MPD 5: POWER ELECTRONIC SIMULATION LABORATORY	-	3	40	60	125
TOTAL	**12**	**07**	**440**	**160**	**600**
SECOND SEMESTER					
2MPD 1: INDUSTRIAL ELECTRONICS	3	1	100	25	125
2MPD 2: SWITCHED MODE POWER CONVERSION	3	1	100	25	125
2MPD 3: ADVANCED ELECTRIC DRIVES & THEIR CONTROL	3	1	100	25	125
2MPD 4 : ELECTIVE-I	3	1	100	25	125
2MPD 5 : DRIVES LABORATORY	-	3	40	60	100
TOTAL	**12**	**07**	**440**	**160**	**600**
THIRD SEMESTER					
3MPD 1 : ELECTIVE-I	3	1	100	25	125
3MPD 2 : ELECTIVE-II	3	1	100	25	125
3MPD 3 : SEMINAR	-	4	60	90	150
3MPD4 : DISSERTATION PART I	-	4	-	100	100
TOTAL	**06**	**10**	**260**	**240**	**500**
FOURTH SEMESTER					
4MPD1 : DISSERTATION PART II	-	16	-	500	500
TOTAL	-	**16**	-	**500**	**500**
GRAND TOTAL	**30**	**40**	**1170**	**1030**	**2200**

LIST OF ELECTIVES

2 MPD 4: ELECTIVE-I
2 MPD 4.1 POWER QUALITY
2 MPD 4.2 POWER SYSTEM DYNAMICS
2 MPD 4.3 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS
3 MPD 1: ELECTIVE-I
3 MPD 1.1 FLEXIBLE AC TRANSMISSION SYSTEMS
3 MPD 1.2 HVDC TRANSMISSION
3 MPD 1.3 MICRO CONTROLLER BASED SYSTEM DESIGN
3 MPD 2: ELECTIVE-II
3 MPD 2.1 DIGITAL SIGNAL PROCESSING
3 MPD 2.2 MODERN CONTROL TECHNIQUES IN ELECTRIC DRIVES
3 MPD 2.3 FUZZY LOGIC AND NEURAL NETWORKS

DETAILED SYLLABUS

SEMESTER I

1 MPD 1: ADVANCED POWER SEMICONDUCTOR DEVICES

Unit I

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.

Unit II

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.

Unit III

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 GATT.

Unit IV

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.

Unit V

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.

Suggested Readings:

1. Power Electronics Circuits, Devices and Applications,Rashid M. H.
2. Power Electronics: Devices, Drivers, Applications and Passive Component B.W. Williams
3. Power Electronics ,M. D. Singh and K. B. Khanchandani.
4. Power Electronics – Concepts, applications and Design Mohan, Undeland and Robins
5. Power Electronics, Essentials and Applications L. Umanand,

1 MPD 2: ADVANCED POWER ELECTRONICS

Unit I

Phase Controlled Converters: Performance measures of single and three-phase converters with discontinuous load current for R, RL and RLE loads. Effect of source inductance for single and three-phase converters

Unit II

Chopper: Review of choppers configurations, Steady state analysis of type A Chopper, Minimum and Maximum Currents, Ripple and average load current, Commutation in Chopper Circuits.

Unit III

Inverters: Performance parameters, voltage control of three phase inverters-Sinusoidal PWM, Third Harmonic PWM, 60 degree PWM and Space Vector Modulation. Harmonic reductions

Unit IV

AC Voltage Controllers: Single and Three Phase AC Controllers. AC Voltage Controller with PWM Control

Unit V

Cyclo-Converters: Single phase and three phase Cyclo-converters, Reduction in Output Harmonics, Matrix Converter.

Suggested Readings:

1. M. H. Rashid, Power Electronics-Circuits, Devices and Applications, 3rd Edition, PHI, 2005
2. Ned Mohan, T.M. Undeland and William P.Robbins, Power Electronics: Converters, Applications, 3rd Edition, John Wiley & Sons, 2009.

1 MPD 3: ELECTRICAL MACHINE MODELING AND ANALYSIS

Unit I

Basic Principle of Electrical Machines: Introduction, Magnetically coupled circuit, Electromagnetic energy conversion, machine winding and air gap EMF, winding inductance and voltage equations, equation of transformation, Reference-Frame Theory.

Unit II

Fundamental of Electrical Drives: Introduction, Choice of Electrical Drives, Dynamics of Electrical Drives, Concept of Multi-quadrant operation, Components of load torques, Selection of motor power rating, Speed torque, speed control, Starting, Braking.

Unit III

DC Drives: Modeling, Rectifier fed DC drive, Chopper controlled DC drives, Close loop control of DC drive. Analysis of steady state and dynamic operation

Unit IV

Symmetrical Induction Machines: Introduction, voltage and torque equations in machine variables, voltage and torque equations in arbitrary reference frame, Analysis of steady state and dynamic operation.

Unit V

Synchronous Machines: Introduction, voltage and torque equations in machine variables, voltage equations in rotor reference frame, Analysis of steady state and dynamic operation.

Suggested Readings:

1. P. C. Krause, Oreg Wasynczuk, Scott D. Sudhoff P.C.Krause, Oreg Wasynczuk, Scott D.

Sudhoff, “Analysis of Electric Machinery and drive systems” , IEEE Press, 2002.
2. P. S. Bhimbra, “Generalised Theory of Electrical Machines “, Khanna Publications 2013.
3. G. K. Dubey, “Fundamentals of Electrical Drives” Narosa, 2009.
4. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall international, New Jersey, 1989.
5. R. Krishnan, “Electric Motor Drives Modeling, Analysis and Control” PHI-India, 2005.

1 MPD 4: MODERN CONTROL SYSTEM

Unit I

State Space Analysis: Concept of state, state space representation of systems, phase variable form, canonical variable form, physical variable form, Diagonalization, relationship between state equation and transfer function, solution of state equation, concept of controllability and observability, eigen values and eigen vector.

Unit II

Sampled Data System: importance of sampling, mathematical analysis of sampling, spectrum analysis of sampling process, Shanon’s Theorem, signal reconstruction, hold circuit, Z transform, inverse Z transform, difference equation, pulse transfer function, state variable representation of sampled data system, and solution of discrete state equation.

Unit III

Non Linear system: characteristic of nonlinear system, type of non-linearity, jump resonance, limit cycle, describing function method of analysis.

Unit IV

Liapunov Stability Criteria: Introduction, stability definitions and theorems, Liapunov function for linear system.

Suggested Readings:

1. Nagrath & M. Gopal, “Control System Engineering”, New Age International Publications, 2009
2. B. S. Manke, “Control System Design” Khanna Publications, 2011.
3. Ogata, “Modern Control Engineering” Pearson Education, 2008.
4. D. Roy Choudhary, “Modern Control Engineering”, Dhanpat Rai & Sons Publication, 2008.

1 MPD 5: POWER ELECTRONIC SIMULATION LABORATORY

1. Single phase semi converter with R-L load
2. Single Phase Semi-converter with R-L and R-L-E loads for continuous and discontinuous conduction modes.
3. Single-phase full- converter with R-L and R-L-E loads for continuous and discontinuous conduction modes.
4. Three phase full-converter with R-L-E load.
5. Three phase semi converter with R-L-E Load
6. MOSFET, IGBT based Choppers.
7. IGBT based Single-phase inverters.
8. Single phase AC voltage controller.
9. Three phase AC voltage controller.

Suggested Readings:

1. Power Electronics Laboratory; Theory, Practice and Organization, by O. P. Arora, Narosa Publication 2007.

DETAILED SYLLABUS

SEMESTER II

2 MPD 1: INDUSTRIAL ELECTRONICS

Unit I

Stabilized Power Supplies: Uninterrupted power supplies, online UPS, offline UPS, high frequency online UPS, programmable logic controllers, Voltage stabilizers-servo mechanism, single phase & three phase servo voltage stabilizers.

Unit II

Amplifiers in Industrial Electronic Circuits & Industrial Timing Circuits: Introduction, Direct coupled amplifiers (DCA)-basic & special, differential amplifier as DCA, chopper stabilized DCA, differential DCA using Op-Amp, Timers-classification, thermal, electromechanical, electronic timers, transistor coltrol with relay load control, SCR delay timer, IC electronic timer.

Unit III

Optoelectronics & Optical Fiber: Introduction, photoemitters, lasers, liquid crystal displays, photoconductive sensors, photodiodes, phototransistors, LASCRs/photo SCRs, optocouplers, solid state relays (light operated relays), optical fiber.

Unit IV

Storage Systems: Introduction, Energy Storage Parameters, Lead–Acid Batteries-Constructional Features, Battery Charge–Discharge Cycles, Ultra capacitors-Double-Layer Ultra capacitors, High-Energy Ultra capacitors, Applications of Ultra capacitors, Flywheels-Advanced Performance of Flywheels, Applications of Flywheels.

Unit V

Heating & Welding Control : Induction heating, Effects of supply frequency & source voltage on induction heating, Dielectric heating, Effect of variation of supply voltage & frequency on dielectric heating, Welding, Resistance welding-theory & classification, scheme of AC resistance welding, Ignitron-heat control by change of firing angles in Ignitrons, complete control in resistance welding by a sequence timer.

Suggested Readings:

1. Industrial and Power Electronics /G.K.Mithal and Dr.Maneesha Gupta
2. Industrial Electronics and control /Biswanath Paul.

2 MPD 2: SWITCHED MODE POWER CONVERSION

Unit I

Single-Switch Isolated Converters: Requirement for isolation in the switch-mode converters, transformer connection, Forward and flyback converters, power circuit and steady-state analysis, Push-Pull Converters-Power circuit and steady-state analysis, utilization of magnetic circuits in single switch and push-pull topologies

Unit II

Isolated Bridge Converters: Half bridge and full-bridge converters, Power circuit and steady state analysis, utilization of magnetic circuits and comparison with previous topologies

Unit III

Dynamic Analysis of DC-DC Converters: Formulation of dynamic equation of buck and boost converters, averaged circuit models, linearization technique, small-signal model and converter transfer functions.

Unit IV

Controller Design: Review of frequency-domain analysis of linear time-invariant systems, concept of bode plot, phase and gain margins, bandwidth, controller specifications, proportional (P), proportional plus integral (PI), proportional plus integral plus integral controller (PID), selection of controller parameters.

Unit V

Resonant Converters: Classification of Resonant converters-Basic resonant circuits- Series resonant circuit-parallel resonant circuits- Resonant switches, Concept of Zero voltage switching, principle of operation, analysis of M-type and L-type Buck or boost Converters. Concept of Zero current switching, principle of operation, analysis of M-type and L-type Buck or boost Converters

Suggested Readings:

1. Fundamentals of Power Electronics – Robert Erickson and Dragon Maksivimovic,
2. Power Electronics–Issa Batarseh- John Wiely ,Springer Publications.
3. Elements of Power Electronics - Philip T.Krein – Oxford University Press

4. Power Electronics, L. Umanand, Tata Mc-Graw Hill
5. Switched Mode Power Conversion, Course Notes, CCE, IISc, 2004.
6 Power Electronic Circuits, Issa Batarseh, John Wiley, 2004.

2 MPD 3: ADVANCED ELECTRIC DRIVES & THEIR CONTROL

Unit I

Characteristics of Electric Motors: Characteristics of DC motors, 3-Phase induction motors and synchronous motors, Starting and braking of electric motors. Dynamics of Electric Drives, Mechanical system, Fundamental torque equations, components of load torques, Dynamic conditions of a drive system, Energy loss in transient operations, Steady State Stability, Load equalization.

Unit II

DC Motor Drives: Starting, Braking and Speed Control, Transient analysis of separately excited motor with armature and field control, Energy losses during transient operation, Phase controlled converter fed DC drives, Dual-converter control of DC drive, Supply harmonics, Power factor and ripple in motor current, Chopper Control DC drives, Source current harmonic in Choppers.

Unit III

Induction Motor Drives: Starting, Braking and transient analysis, Calculation of energy losses, Speed control, Stator voltage control, Variable frequency control from voltage and current sources, Slip power recovery-Static Scherbius and Cramer drives.

Unit IV

Synchronous Motor Drives: Starting, Pull in and braking of synchronous motors, Speed control – variable frequency control, cycloconverters control, Brushless DC Motor, Linear Induction Motor, Stepper Motor and Switched Reduction Motor Drives, Important features and applications.

Unit V

Energy Conservation in Electrical Drives: Losses in electrical drive system, Measures for energy conservation in electric drives, Use of efficient motor, Energy efficient operation of drives, Improvement of power factor and quality of supply.

Suggested Readings:

1. G. K. Dubey : Fundamentals of Electrical Drives, 2nd Edition, Alpha Science International, 2001.

2. S. B. Dewan, Gordon R. Slemon and A. Straughen: Power Semiconductor Drives, John Wiley Pub.1996.
3. R. Krishnan: Electric Motor drives - Modelling, Analysis and Control, PHI India Ltd., 2002.
4. W. Shepherd, D. T. W. Liang and L.N. Hulley: Power Electronics and Motor Control, 2nd Edition, Cambridge Univ. Press, 1995.

2 MPD 4.1: POWER QUALITY

Unit I

Introduction to Power Quality: What is Power Quality, Voltage Quality, Why are we concerned about power quality, The power quality evaluation procedure-Need for a consistent Vocabulary, General classes of power quality problems, Transients, Long-Duration voltage variations, Short-Duration voltage variations, Voltage Imbalance, waveform distortion, voltage fluctuation, Power frequency variations, Power quality terms.

Unit II

Voltage Sags and Interruptions: Sources of sags and interruptions-Estimating Voltage sag performance-Fundamental principles of protection-Solutions at the End-User level-Evaluating the economics of different ride through alternatives-Motor starting sags-Utility system fault_ clearing issues.

Unit III

Fundamentals of Harmonics: Harmonic Distortion-Voltage versus current distortion-Harmonic versus Transients-Power system Quantities under non sinusoidal conditions-Harmonic indices-Harmonic sources from commercial loads-Harmonic sources from industrial loads-Locating harmonic sources-System response characteristics-Effects of harmonic distortion- Inter harmonics.

Unit IV

Applied Harmonics: Harmonic Distortion Evaluation-Principles of Controlling Harmonics-Where to control Harmonics? - Harmonic studies-Devices for controlling Harmonic Design-Harmonic filter Design.

Unit V

Power Quality Monitoring: Monitoring considerations-Historical perspective of power quality measuring instruments-Power quality measurement equipment-Assessment of power quality measurement data-Application of intelligent systems-Power quality monitoring standards.

Suggested Readings:

1. Electrical power systems quality-Roger C.Dugan- McGraw- Hills
2. Power quality- C.Sankaran, CRC Press
3. Electrical power systems quality-Roger C.Dugan- McGraw- Hills
4. Power quality- C.Sankaran, CRC Pressaul.

2 MPD 4.2: POWER SYSTEM DYNAMICS

Dynamic models of synchronous machines, Excitation system, Turbines, Governors, Loads, Modeling of single machine infinite bus system, Mathematical Modeling of multi-machine System, Dynamic and transient stability analysis of single machine and multi-machine system, Power system stabilizer design for multi-machine system, Techniques for the improvement of stability.

Suggested Readings:

1. Padiyar, K. R., Power System Dynamics, Stability and Control, B. S. Publications, 2nd edition, 2002.

2 MPD 4.3: POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

Unit I

Introduction to Renewable Energy Systems: Wind power, Hydropower, Solar energy-Biomass, Bio-fuel, Geothermal Heat energy, Solar-thermal plants, Applications.

Unit II

Solar Energy : Introduction to PV-Cells, Array, Solar power extraction using PV-Cells, I-V Characteristics, PV-Inverters without D.C. to D.C. converters, Grid interfacing-with isolation, without isolation, Maximum power point tracking-Methods, PV-Inverters with D.C. to D.C. converters-on low frequency side and high frequency side with isolation, without isolation.

Unit III

Wind Energy: Sources and potentials, Evaluation of Wind Intensity, Topography, General Classification of Wind Turbines-Rotor Turbines, Multiple-Blade Turbines, Drag Turbines, Lifting Turbines, System TARP–WARP, Generators and speed control used in wind power Energy.

Unit IV

Wind Power Control: Fixed speed with capacitor bank, Rotor resistance control, DFIG, Synchronous Generator-external magnetized, Synchronous Generator-permanent magnets.

Unit V

Fuel Cells: Fuel cells, Commercial Technologies for Generation of Electricity, Constructional Features of Solid Oxide Fuel Cells, Constructional Features of Proton Exchange Membrane Fuel Cells, Load Curve Peak Sharing with Fuel Cells, Advantages and Disadvantages of Fuel Cells, voltage step-up using D.C.-D.C. converter- with and without battery storage, Voltage controller for Fuel cell using D.C. – D.C. converter, Inverter interaction with fuel cell for A.C. loads, A.C. Voltage build-up and controller for fuel cells- using power converters and transformers (isolation).

Suggested Readings:

1. Non-Conventional Energy Sources /G.D. Rai.
2. Renewable Energy Technologies /Ramesh & Kumar –Narosa publication.
3. Integration of alternative sources of energy /Felix A. Farret, M. Godoy simoes.
4. Wind power plants and projects developments, Joshua Earnest and T Wizelius, PHI, New Delhi, 2011.
5. Handbook of renewable energy technology, World Scientific, Singapore, 2011.

2 MPD 5: DRIVES LABORATORY

1. Operation of 3-phase fully controlled Converter with R & R-L load.
2. Performance & Operation of a four quadrant Chopper fed D.C. Drive
3. Performance & Operation of a 3-phase A.C. Voltage controller on motor load.
4. Operation of 3-phase IGBT based PWM Inverter on R & R-L load.
5. Operation of 3-phase multilevel Inverter
6. Performance & speed control of 3 phase slip ring Induction motor by Static Rotor Resistance Controller.
7. PIC Microcontroller based Power factor correction with Boost converter
8. Speed control of BLDC motor with spring-balance.
9. Speed control of Switched Reluctance motor with eddy current load.
10. DSP based V/F Control of 3 phase Induction motor.

Suggested Readings:

1. Power Electronics Laboratory; Theory, Practice and Organization, by O. P. Arora, Narosa Publication 2007.

DETAILED SYLLABUS

SEMESTER III

3 MPD 1.1: FLEXIBLE AC TRANSMISSION SYSTEMS

Unit I

Problems of AC transmission systems, power flow in parallel paths and meshed system, factors limiting loading capability, stability consideration, Power flow control of an ac transmission line, Basic types of facts controllers, Advantages of FACTS technology.
(i) Voltage-Sourced Converters: Basic concept of voltage-sourced converters, single and three phase bridge converters. Introduction to power factor control. Transformer connections for 12-pulse, 24 pulse and 48 pulse operations.
(ii) Static Shunt Compensators: Midpoint and end point voltage regulation of transmission line, and stability improvement, Basic operating principle of Static Synchronous Compensators (STATCOM), Comparison between STATCOM and SVC.

Unit II

Static Series Compensators: Concept of series capacitive compensation, voltage and transient stabilities, power oscillation and subsynehronous oscillation damping, Introduction to thyristor switched series capacitor (TSSC), thyristor controlled series capacitor (TCSC), and static synchronous series compensator-operation, characteristics and applications.

Unit III

(i) Static Voltage and Phase Angle Regulators: Voltage and phase angle regulation. Power flow control and improvement of stability by phase angle regulator.
ii) Introduction to thyristor controlled voltage and phase angle regulators (TCVR and TCPAR), Introduction to thyristor controlled braking resistor and thyristor controlled voltage limiter.

Unit IV

UPFC: Unified Power Flow Controller (UPFC), basic operating principles, conventional transmission control capabilities, Comparison of UPFC to series compensators and phase angle regulator. Applications of UPFC

Unit V

IPFC: Interline Power Flow Controller (IPFC), basic operating principles and characteristics. Applications of IPFC

Suggested Readings:

1. Narain G.Hingorani, Laszio. Gyugy.L, "Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers –Delhi 2001.

3MPD1.2 HVDC TRANSMISSION

Unit I

Thyristor Valve: Thyristor device, Steady state and switching characteristics, light activated power thyristor, LED, fiber optics, valve firing, parallel and series connections of thyristors.

Unit II

Converter Circuits: Rectification and inversion, effect of reactance, six pulse and twelve pulse converter circuits.

Unit III

DC Link Control: Principles of DC link control, Converter control characteristics, System control hierarchy, Firing angle control, Extinction angle control, starting, stopping and power flow reversal of DC link, Power control, Parallel operation of DC link with AC transmission line. Converter faults, commutation failure, valve blocking and bypassing, Protection against over currents, over voltages. DC circuit breakers, Reactive Power Control: Reactive power requirement in steady state, Sources of reactive power and reactive power control.

Unit IV

Harmonic and Filters: Generation of harmonics, AC and DC side harmonics, characteristics and non-characteristics harmonics. Types of AC filters – single tuned and double tuned filters, high pass filter, DC Smoothing reactor and filters.

Unit V

Scheme of a HVDC: converter station and components of HVDC transmission system. Multi Terminal DC (MTDC) Systems: Types of MTDC systems, Comparison of series and parallel MTDC systems, Control and protection of MTDC systems, Application of MTDC systems.

Suggested Readings:

1. K.R. Padiyar: HVDC Power Transmission System, 2nd Edition, New Age Intl. Pvt. Ltd., 2012.

3 MPD 1.3: MICRO CONTROLLER BASED SYSTEM DESIGN

Unit I

Introduction: Embedded systems and their characteristics, review of micro – processors, MPU design options, Instruction sets – CISC and RISC – instruction pipelining, the microcontroller – its applications and environment.

Unit II

16 Bit Microcontroller: Intel 8096 CPU structure, register file – assembly language overview – addressing modes – Instruction set – simple programs, introduction, PIC microcontrollers PIC 16 C6x/7x, architecture, register file structure and addressing modes, Instruction set, simple programs

Unit III

Peripheral functions of PIC: 16C6x/7x - Interrupts - Interrupts constraints – Interrupt servicing – Critical regions – External Interrupts – Use of Timers in interrupt Handling – Compare and capture mode – PWM outputs.

Unit IV

I/O Port Expansion: Synchronous serial port module – State machines and key switches LCD display – I2C bus operations and subroutine – serial EEPROM.

Unit V

Analog to Digital converter: Characteristics and use, UART: Initialization – Data Handling circuitry and USE, Special Features of PIC – Reset Alternatives Low power operation – Serial programming – parallel slave port

Suggested Readings:

1. John B. Peatman, “Design with PIC Microcontrollers”, Pearson Education Asia, 2004.
2. John B. Peatman, “Design with Microcontrollers”, McGraw Hill, 1995.
3. Michael Khevi, ‘The M68HC11 Microcontroller Applications in control, Instrumentation and communication’, Prentice Hall, New Jersey, 1997
4. Muhammad Ali M azid & Janice Gilli Mazidi, “The 8051 Microcontroller and Embedded systems”, Pearson Education, 1998.

3 MPD 2.1: DIGITAL SIGNAL PROCESSING

Unit I

Introduction to Signal Processing: Review of Laplace transform, Z transform, Fourier transform, Discrete Fourier transform, Fast Fourier transform, Algorithms and complexity, Introduction to linear optimal filtering.

Unit II

Digital Filter: Definition and anatomy of a digital filter, Frequency domain description of signals and systems, typical application of digital filters, Replacing analog filters with digital filters, Filter categories: recursive and non-recursive.

Unit III

Digital Filter Structures: The direct form I and II structures, Cascade combination of second order sections, Parallel combination of second order sections, Linear- phase FIR filter structures, Frequency sampling structure for the FIR filter

Unit IV

Effect of Word Length: Round off error, Truncation error, Quantization error, Limit cycle.
Introduction to DSP Hardware: Application of DSP in control system and instrumentation

Suggested Readings:

1. Oppenheim, and R. W. Shaffer, Discrete Time Signal Processing, Prentice Hall, 1992.
2. J. Johnson, Digital Signal Processing, Prentice Hall
3. Proakis J. G. and D. G. Manolakis, Introduction to Digital Signal Processing (4e), PHI, 2007.
4. Mitra S. K., DSP: A computer based approach (2e), TMH, 2006.
5. Douglas O. Shaghnessy, Speech communication – Human & Machines (2e), Wiley-IEEE Press 1999.
6. Gonzalez R. C. & Woods R. E, Digital Image Processing, Pearson, 2005.
7. Venkataramani B. & Bhaskar M, Digital Signal Processors, TMH 2002.

3 MPD 2.2: MODERN CONTROL TECHNIQUES IN ELECTRIC DRIVES

Unit I

Vector Control of Induction Motor: Principles of vector control, direct vector control, derivation of indirect vector control, implementation-block diagram, estimation of flux, flux weakening operation.

Unit II

Sensorless Vector Control of Induction Motor: Slip and speed estimation at low performance, rotor angle and flux linkage estimation at high performance-rotor speed estimation scheme estimators using rotor slot harmonics, model reference adaptive systems, extended Kalamn filter, injection of auxiliary signal on salient rotor.

Unit III

Control of Synchronous Motor Drives: Synchronous motor and its characteristics- Control strategies-Constant torque angle control- power factor control, constant flux control, flux weakening operation, Load commutated inverter fed synchronous motor drive, motoring and regeneration, phasor diagrams.

Unit IV

Control of Switched Reluctance Motor Drives: SRM Structure-Stator Excitation-techniques of sensor less operation-convertor topologies-SRM Waveforms-SRM drive design factors-Torque controlled SRM-Torque Ripple-Instantaneous Torque control -using current controllers-flux controllers.

Unit V

Control of BLDC Motor Drives: Principle of operation of BLDC Machine, Sensing and logic switching scheme, BLDM as Variable Speed Synchronous motor-methods of reducing Torque pulsations -Three-phase full wave Brushless dc motor -Sinusoidal type of Brushless dc motor - current controlled Brushless dc motor Servo drive.

Suggested Readings:

1. Electric Motor Drives Modeling, Analysis & control -R. Krishnan- Pearson Education
2. Modern Power Electronics and AC Drives –B. K. Bose-Pearson Publications
3. Sensorless Vector Direct Torque control –Peter Vas, Oxford University Press
4. Power Electronics control of AC motors – MD Murphy & FG Turn Bull Pergman Press -1st edition-1998.
6. Fundamentals of Electrical Drives – G.K. Dubey – Narosa Publications -1995
7. Power Semiconductor drives- G.K. Dubey-Prentice hall

3 MPD 2.3: FUZZY LOGIC AND NEURAL NETWORKS

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

Analysis of Neural Networks: Analysis of Neural Network for liner and non-liner systems, Analysis of neuro -fuzzy systems, Application of neural networks.

Suggested Readings:

1. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999.
2. Kosko B. "Neural Networks and Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994
3. Klir G.J. &Folger T.A. "Fuzzy sets, uncertainty and Information", Prentice-Hall of India Pvt. Ltd., 1993.
4. Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 1994.
5. Fuzzy Neural Network Theory and Applications by Liu,Puyin & Li,Hongxing,World Scientific Publication,2004.