Scheme of Examination

Second Semester –M.Tech. (Power Electronics)

S.No.	Subject Code	Subject Name	Periods /week			Total Credits	Maximum Marks Allotted					Total Marks
							Theory Slot			Practical Slot		
			L	T	P		End Sem. Exam.	Tests (Two)	Assignments /Quiz	End Sem. Practical / Viva	Practical Record/ assignment/ Quiz/Presentation	
1.	MEPE-201	Flexible AC Transmission Systems (Facts)	3	1	-	4	70	20	10	-	-	100
2.	MEPE-202	Special Electrical Machines	3	1	-	4	70	20	10	-	-	100
3.	MEPE-203	Advance Microprocessors & Applications	3	1	-	4	70	20	10	-	-	100
4.	MEPE-204	Solid State DC Drives	3	1	-	4	70	20	10	-	-	100
5.	MEPE-205	Solid State AC Drives	3	1	-	4	70	20	10	-	-	100
6.	MEPE-206	Lab -1: Ad. Microprocessor Lab	-	-	6	6	-	-	-	90	60	150
7.	MEPE-207	Lab -2 : Power Electronics Application to Power System Lab(Software Based)	-	-	6	6	-	-	-	90	60	150
		Total	15	5	12	32	350	100	50	180	120	800

L: Lecture- T: Tutorial- P: Practical

M .Tech II Semester Syllabus (Power Electronics)

MEPE- 201 Flexible Ac Transmission Systems

Unit I - Introduction
Review of basics of power transmission networks-control of power flow in AC transmission line- Analysis of uncompensated AC Transmission line Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer- Need for FACTS controllers- types of FACTS controllers.

Unit II - Static Var Compensator (SVC)
Configuration of SVC- voltage regulation by SVC- Modeling of SVC for load flow analysis-Modelling of SVC for stability studies-Design of SVC to regulate the mid-point voltage of a SMIB system- Applications: transient stability enhancement and power oscillation damping of SMIB system with SVC connected at the mid-point of the line.

Unit III - Thyristor and GTO Thyristor Controlled Series Capacitors (TCSC and GCSC)
Concepts of Controlled Series Compensation – Operation of TCSC and GCSC- Analysis of TCSC-GCSC – Modelling of TCSC and GCSC for load flow studies- modeling TCSC and GCSC for stability studied- Applications of TCSC and GCSC.

Unit IV - Voltage Source Converter Based Facts Controllers
Static synchronous compensator(STATCOM)- Static synchronous series compensator(SSSC)-Operation of STATCOM and SSSC-Power flow control with STATCOM and SSSC- Modelling of STATCOM and SSSC for power flow and transient stability studies –operation of Unified and Interline power flow controllers (UPFC and IPFC)- Modelling of UPFC and IPFC for load flow and transient stability studies- Applications.

Unit V - Controllers and Their Co-Ordination
FACTS Controller interactions – SVC–SVC interaction - co-ordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination.

Reference Books
1. Modern power system analysis D.P. Kothari, I.J. Nagrath, TMH, 2003
2 Power generation operation and contrl A.J. Wood, B.F. Woolenberg, jhonwieldy, 1996
3. Understanding facts: Concepts and technologies of flexible AC transmission system IEEE Press,2001 N.G. Hingorani, L. Gyugyi
4. Power system stability and control IEEE press P. Kundur, 1994
5. Thyristor Based FACTS controllers for electrical Transmission systems- R.M.Mathur, R.K. Verma, Wieldy Inter science, 2002
6. FACTS Controllers in Power Transmission and Distribution,-K.R.Padiyar,New Age International (P) Ltd., Publishers, New Delhi, Reprint, 2008.
7. Flexible AC Transmission System,- A.T.John, Institution of Electrical and Electronic Engineers (IEEE), 1999

MEPE -202 Special Electrical Machines

UNIT I -Stepper Motor

Introduction, Types, Hybrid stepper motor- construction, principle of operation, two phases energized at a time, conditions for operation, different configurations, VR Stepper motor- single stack and multi stack, Drive systems and circuit for open loop and Closed loop control of stepping motor, Dynamic characteristics ,Single phase stepper Motor, Expression of voltage, current and torque for stepper motor and criteria for synchronization.

UNIT II- Switched Reluctance Motor

Constructional features, principle of operation, Design Aspects and profile of the SRM, Torque equation, Power converters and rotor sensing mechanism, expression of torque and torque-speed characteristics.

UNIT III- Permanent Magnet synchronous motor

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

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UNIT IV- Permanent magnet Brushless DC Motor

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- Synchronous reluctance motors

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

Reference books:-

1. Vekatratnam, “Special Electrical Machines”, Universities Press
2. Fitzerald and Kingsley,” Electrical Machines” McGraw Hill. Miller. T. J. E., “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press, Oxford, 1989.
3. Kenjo. T and Nagamori. S, “Permanent Magnet and Brushless DC Motors”, Clarendon Press, Oxford, 1989.
4. Kenjo. T, “Stepping Motors and their Microprocessor Control”, Clarendon Press, Oxford, 1989
5.. Krishnan R, “Switched Reluctance Motor Drives”, Modelling, Simulation, Analysis, Design and applications, CRC press

MEPE -203 Advance Microprocessors and Applications

UNIT I- Introduction to Microprocessors and Microcontrollers

Review of basics microprocessor, architecture and instruction set of a typical 8 bit microprocessor, Overview of 16 bit & 32 bit microprocessors, arithmetic and I/O coprocessors. Architecture, register details, operation, addressing modes and instruction set of 16 bit 8086 microprocessor, assembly language programming, introduction to multiprocessing, multi-user, multitasking operating system concepts, Pentium-1,2,3 and 4 processors, Motorola 68000 processor, Concepts of micro controller and micro computer, microcontroller (8051/8751) based design, applications of microcomputer in on line real time control.

UNIT II- Input-Output Memory Interfacing

Parallel and series I/O, Interrupt driven I/O, single and multi interrupt levels, use of software polling and interrupt controlling for multiplying interrupt levels, programmable interrupt controller, DMA controller, programmable timer/counter, programmable communication and peripheral interface, synchronous and asynchronous data transfer, standard serial interfaces like RS 232. Types of Memory, RAM & ROM interfacing with timing considerations.

UNIT III- Programmable Support Chips

Functional schematic operating modes, programming and interfacing of 8255, 8251 , 8259 and 8253 with microprocessor.

UNIT IV- Analog Input & Output

Microprocessor compatible ADC and DAC chips, interfacing of ADC and DAC with microprocessor, user of sample and hold circuit and multiplexer with ADC.

UNIT V- Microprocessor Applications

Application of Microprocessors, Microcomputer-based Industrial Process-control System, Hardware for Control Systems and Temperature Controller, Overview of Smart-Scale Operation. Design methodology, examples of microprocessor applications.

References:

1. Advanced Microprocessors, PHI, D.V.Hall
2. The Intel Processors, Pearson Education, B. Brey
3. Gibson, “Microprocessors”, Prentice Hall of India.
4. K.J. Ayala, “Micro Controller”, Penram International
5. Advanced Microprocessors, A.K. Ray, K.M.Bhurchandi, TMH
6. Microprocessor, Gaonkar

MEPE -204 Solid State DC Drives

UNIT I - DC Motors Fundamentals and Mechanical Systems

DC motor- Types, induced emf, speed-torque relations; Speed control – Armature and field speed control; Ward Leonard control – Constant torque and constant horse power operation - Introduction to high speed drives and modern drives, Characteristics of mechanical system – dynamic equations, components of torque, types of load; Requirements of drives characteristics - stability of drives – multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

UNIT II -Converter Control

Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters – waveforms, performance parameters, performance characteristics. Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with freewheeling diode; Implementation of braking schemes; Drive employing dual converter.

UNIT III -Chopper Control

Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control - Chopper based implementation of braking schemes; Multi-phase chopper; Related problems.

UNIT IV -Closed Loop Control

Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements - Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Simulation of converter and chopper fed d.c drive.

UNIT V -Digital Control of D.C Drive

Phase Locked Loop and micro-computer control of DC drives – Program flow chart for constant Horse power and load disturbed operations; Speed detection and current sensing circuits.

References

1. Gopal K Dubey, “Power Semiconductor controlled Drives”, Prentice Hall Inc., New Yersy,1989.
2. R.Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2010.
3. Gobal K.Dubey, “Fundamentals of Electrical Drives”, Narosal Publishing House, New Delhi, Second Edition ,2009
4. Vedam Subramanyam, “Electric Drives – Concepts and Applications”, Tata McGraw-Hill publishing company Ltd., New Delhi, 2002.
5. P.C Sen “Thyristor DC Drives”, John wiely and sons, New York, 1981

MEPE- 205 Solid State AC Drives

UNIT I - Introduction to Induction Motors
Steady state performance equations – Rotating magnetic field – torque production, Equivalent circuit– Variable voltage, constant frequency operation – Variable frequency operation, constant Volt/Hz operation. Drive operating regions, variable stator current operation, different braking methods.

UNIT II -VSI and CSI Fed Induction Motor Control
AC voltage controller circuit – six step inverter voltage control-closed loop variable frequency PWM inverter with dynamic braking-CSI fed IM variable frequency drives comparison.

UNIT III -Rotor Controlled Induction Motor Drives
Static rotor resistance control - injection of voltage in the rotor circuit – static scherbius drives - power factor considerations – modified Kramer drives

UNIT IV- Field Oriented Control
Field oriented control of induction machines – DC drive analogy – Direct and Indirect methods – Flux vector estimation - Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy.

UNIT V -Synchronous Motor Drives
Wound field cylindrical rotor motor – Equivalent circuits – performance equations of operation from a voltage source – Power factor control and V curves – starting and braking, self control – Load commutated Synchronous motor drives - Brush and Brushless excitation.

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. Gopal K Dubey, “Power Semiconductor controlled Drives”, Prentice Hall Inc., New Yersy, 1989.
4. R.Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice-Hall of IndiaPvt. Ltd., New Delhi, 2003.
5. W.Leonhard, “Control of Electrical Drives”, Narosa Publishing House, 1992.
6. Murphy J.M.D and Turnbull, “Thyristor Control of AC Motors”, Pergamon Press, Oxford, 1988.