COURSE STRUCTURE AND SYALLABUS FOR 2009-2011
M. TECH. (POWER ELECTRONICS)

I SEMESTER

Code	Group	Subject	L	P	Credit
		Machine Modeling & Analysis	3	0	3
		Analysis of Power Electronic Converters	3	0	3
		Modern Control Theory	3	0	3
		Power electronic Control of DC Drives	3	0	3
	Elective -1	1. HVDC Transmission	3	0	3
		Operations Research			
		Modern Power electronics			
	Elective -2	Programmable logic controllers and their applications	3	0	3
		Energy Conservation Systems			
		Dynamics of Electrical Machines			
	Lab	Power Converters Lab	0	3	2
		Seminar	-	-	2
		Total Credits (6 Theory + 1 Lab.)			22

II SEMESTER

Code	Group	Subject	L	P	Credits
		Power Electronic control of AC Drives	3	0	3
		Microprocessor and Microcontroller	3	0	3
		Flexible AC Transmission Systems (FACTS)	3	0	3
		Neural And Fuzzy Systems	3	0	3
	Elective -1	Digital Control Systems	3	0	3
		Power Quality			
		Advanced Digital Signal Processing			
	Elective -2	Reliability Engineering	3	0	3
		Enterprise Resource Planning			
		Embedded Systems			
	Lab	Electrical Systems Simulation Lab	0	3	2
		Seminar	-	-	2
		Total Credits (6 Theory + 1 Lab.)			22

II YEAR - I Semester

Code	Group	Subject	L	P	Credit
		Comprehensive Viva	-	-	2
		Project Seminar	0	3	2
		Project work	-	-	18
		Total Credits			22

II YEAR - II Semester

Code	Group	Subject	L	P	Credit
		Project work and Seminar	-	-	22

I- Semester

MACHINE MODELLING AND ANALYSIS

Unit 1: Basic Two-pole DC machine - primitive 2-axis machine - Voltage and Current relationship - Torque equation

Unit 2: Mathematical model of separately excited DC motor and DC Series motor in state variable form - Transfer function of the motor - Numerical problems.

Unit 3: Mathematical model of D.C. shunt motor and D.C. Compound motor in state variable form - Transfer function of the motor - Numerical Problems.

Unit 4: Linear transformation-Phase transformation (a,b,c to a,p,o)-Active transformation(a,p,o to d,q).

Unit 5: Circuit model of a 3 pahse Induction motor - Linear transformation - Phase Transformation - Transformation to a Reference frame - Two axis models for Induction motor.

Unit 6: Voltage and current Equations in stator reference frame - Equation in Rotor reference frame - Equations in a synchronously rotating frame - Torque equation- Equations in state-space form.

Unit 7: Circuit model of a 3ph Synchronous motor - Two axis representation of Syn. Motor.

Unit 8: Voltage and current Equations in state - space variable form - Torque equation.

BOOKS :

1. Thyristor control of Electric Drives - Vedam Subramanyam.
2. Analysis of electric machinery and Drive systems - Paul C.Krause , Oleg wasynezuk, Scott D.Sudhoff

ANALYSIS OF POWER ELECTRONIC CONVERTERS

Unit I Single Phase AC Voltage Controllers.
Single phase AC voltage controllers with Resistive, Resistive-inductive and Resistive-inductive-induced e.m.f. loads - ac voltage controllers with PW Control - Effects of source and load inductances - Synchronous tap changers-Applications - numerical problems.

Unit II Three Phase AC Voltage Controllers.
Three phase AC voltage controllers - Analysis of controllers with star and delta Connected Resistive, Resistive-inductive loads - Effects of source and load Inductances - applications - numerical problems.

Unit IIICycloconverters.
Single phase to single phase cycloconverters - analysis of midpoint and bridge Configurations - Three phase to three phase cycloconverters - analysis of Midpoint and bridge configurations - Limitations - Advantages - Applications- numerical problems.

Unit IVSingle Phase Converters.
Single phase converters - Half controlled and Fully controlled converters -Evaluation of input power factor and harmonic factor - continuous and Discontinuous load current - single phase dual converters - power factor Improvements - Extinction angle control - symmetrical angle control - PWM -single phase sinusoidal PWM - single phase series converters - Applications -Numerical problems.

Unit V Three Phase Converters.
Three phase converters - Half controlled and fully controlled converters -Evaluation of input power factor and harmonic factor - continuous and Discontinuous load current - three phase dual converters - power factor Improvements - three phase PWM - twelve pulse converters - applications -Numerical problems.

Unit VID.C. to D.C. Converters
Analysis of step-down and step-up dc to dc converters with resistive and Resistive-inductive loads - Switched mode regulators - Analysis of Buck Regulators - Boost regulators - buck and boost regulators - Cuk regulators - Condition for continuous inductor current and capacitor voltage - comparison of regulators -Multiouput boost converters - advantages - applications - Numerical problems.

Unit VII Pulse Width Modulated Inverters(single phase).
Principle of operation - performance parameters - single phase bridge inverter -evaluation of output voltage and current with resistive, inductive and Capacitive loads - Voltage control of single phase inverters - single PWM - Multiple PWM - sinusoidal PWM - modified PWM - phase displacement Control - Advanced modulation techniques for improved performance - Trapezoidal, staircase, stepped, harmonic injection and delta modulation - Advantage - application - numerical problems.

Unit VIII Pulse Width Modulated Inverters(three phase).
Three phase inverters - analysis of 180 degree condition for output voltage And current with resistive, inductive loads - analysis of 120 degree Conduction - voltage control of

three phase inverters - sinusoidal PWM - Third Harmonic PWM – 60 degree PWM - space vector modulation - Comparison of PWM techniques
- harmonic reductions - Current Source Inverter - variable d.c. link inverter - boost inverter - buck and boost inverter - inverter circuit design - advantages - applications - numerical problems.

Text books:

1. Power Electronics - Mohammed H. Rashid - Pearson Education -Third Edition - First Indian reprint 2004.
2. Power Electronics - Ned Mohan, Tore M. Undeland and William P. Robbins -John Wiley and Sons - Second Edition

MICROPROCESSORS & MICROCONTROLLERS

Unit 1: 8086/8088 processors : Introduction to 8086 Microprocessors, Architecture, Addressing modes, Instruction set, Register Organization, Assembler directives.

Unit 2: Hard ware description: Pindiagram :signal description min & max modes, bus timing, ready & wait states, 8086 based micro computing **system.**

Unit 3: Special features & Related Programming : Stack structure of 8086, Memory segmentation, Interrupts, ISR, NMI, MI and interrupt Programming, Macros.

Unit 4: Advanced Microprocessors: Intel 80386 programming model ,memory paging, Introduction to 80486, Introduction to Pentium Microprocessors and special Pentium pro features.

Unit 5 :-Basic peripherals & Their Interfacing:-Memory Interfacing (DRAM) PPI-Modes of operation of 8255 ,Interfacing to ADC & DAC.

Unit 6:- Special Purpose of Programmable Peripheral Devices and Their interfacing :-Programmable interval timer , 8253 , PIC 8259A,display controller Programmable communication Interface 8251,USART and Exercises.

Unit 7 :-Microcontrollers : Introduction to Intel 8 bit &16 bit Microcontrollers, 8051-Architecture, Memory organization, Addressing Modes and exercises

Unit 8:- Hardware description of 8051: Instruction formats ,Instruction sets, interrupt Structure & interrupt priorities, Port structures &Operation linear counter Functions ,different Modes of Operation and Programming examples.

TEXT BOOKS :-

1."The Intel Microprocessors" Architecture Programming &Interfacing by Barry b Brey.
2.Advanceed Microprocessors by kenrith J Ayala , Thomson publishers.
3.Microcontrollers by kentrith J ayala,Thomson publishers.

Reference Books:-

1. Microprocessors & Interfacing Programming & Hard ware by DOUGLAS V.Hall
2. Microprocessors & Microcontrollers by Prof. C.R.Sarma

POWER ELECTRONIC CONTROL OF DC DRIVES

Unit-I : controlled Bridge Rectifier (1-Φ) with DC Motor Load:
Separately exited DC motors with rectified single-phase supply – single phase semi converter and single phase full converter for continuous and discontinuous modes of operation – power and power factor.

Unit-II : controlled Bridge Rectifier (3-Φ) with DC Motor Load:
Three-phase semi converter and three phase full converter for continuous and discontinuous modes of operation – power and power factor – Addition of free wheeling diode- Three-phase double converter.

Unit-III : Three phase naturally commutated bridge circuit as a rectifier or as an inverter:
Three phase controlled bridge rectifier with passive load impedance, resistive load and ideal supply – Highly inductive load and ideal supply for load side and supply side quantities, shunt capacitor compensation, three phase controlled bridge rectifier inverter.

Unit-IV: Phase controlled DC Motor drives:
Three phase controlled converter, control circuit, control modeling of three phase converter – Steady state analysis of three phase converter control DC motor drive – Two quadrant, three phase converter controlled DC motor dive – DC motor and load converter.

Unit-V: Current and Speed Controlled DC Motor drives:
Current and speed controllers – current and speed feedback – Design of controllers – current and speed controllers – Motor equations – filter in the speed feed back loop speed controller – current reference generator – current controller and flow chart for simulation – Harmonics and associated problems – sixth harmonics torque.

Unit-VI: Chopper controlled DC Motor drives
Principles of operation of the chopper – four-quadrant chopper circuit – chopper for inversion – Chopper with other power devices – model of the chopper –input to the chopper steady state analysis of chopper controlled DC motor drives – rating of the devices – Pulsating torque.

Unit-VII: Closed loop operation of DC Motor drives
Speed controlled drive system – current control loop – pulse width modulated current controller – hysterisis current controller – modeling of current controller – design of current controller.

Unit-III: Simulation of DC motor drives
Dynamic simulations of the speed controlled DC motor drives – Speed feedback speed controller – command current generator – current controller.

References:

1. Power Electronic and motor control – Shepherd, Hulley, Liang – II Edition, Cambridge University Press.
2. Electric Motor drives modeling, Analysis and control – R. Krishnan – I Edition, Prentice Hall India.
3. Power Electronic circuits, Drives and Applications – M. H. Rashid – PHI – I Edition – 1995
4. Fundamentals of Electric Drives – G.K. Dubey – Narosa Publications – 1995
5. Power Semiconductor drives – S.B. Dewan and A. Straughen

DIGITAL CONTROL SYSTEMS
(Elective-I)

Unit-I: Introduction

Block diagram of typical control system – Advantages of sampling in control systems – Examples of discrete data and digital systems – Data conversion and quantization – sample and hold devices – D-A and A-D conversion – Sampling theorem – reconstruction of sampled signals –ZOH.

Z-Transform: Definition and evaluation of Z-transforms – Mapping between s-plane and z-plane-inverse Z-transform – Theorems of the Z-transforms – Limitation of Z-transform – Pulse transfer function – Pulse transfer function of ZOH – Relation between G(s) and G(z) – signal flow graph method applied to digital systems.

Unit-II: State Space Analysis

State Space modeling of digital systems with sample and hold – State transition equation of digital time in variant systems – Solution of time in variant discrete state equation by the Z-transformation – transfer function from the state model – Eigen values – Eigen vector and diagonalisation of the A-matrix – Jordan Canonical form – computation of state transitions matrix – Transformation to phase to variable canonical form - The state diagram – decomposition of digital system – Response of sample data system between sampling instants using state approach.

Stability: Definition of Stability – Stability tests – The second method of Liapunov.

Unit-III: Time Domain Analysis

Comparison of Time responses of continuous data and digital control systems – correlation between time response and root locus in the s-plane and z-plane – effect of Pole-zero configuration in the z-plane upon the maximum overshoot and peak time of transient response – Root loci for digital control systems – Steady state error analysis of digital control systems – Nyquist plot – Bode plot – G.M. and PM.

Unit-IV: Controllability and Observability

Theorems on controllability – Theorems on Observability (Time invariant systems) Relation between controllability, observability and transfer function – controllability and observability Vs sampling period.

Unit-V: Design

The digital control design with digital controller with biliner transformation – Digital PID controller – Design with dead beat response – Pole placement through state feedback – Design of full order state observer – Discrete Euler Lagrance Equation – Discrete maximum principle.

Unit-VI: Digital State Observer

Design of full order stat observer and reduced state observer

Unit-VII: Design by Max. Principle

Discrete Euler language equitation – Discrete maximum principle.

TEXT BOOK: Digital Control Systems – B.C. Kuo, H.S. International Ediction
Suggested Reading Book: Digital Control Systems – M. Gopal, TMH

OPERATION RESEARCH
(Elective – I)

Unit 1:
Linear Programming Problem: Formulation – Graphical method - Simplex method – Artificial variable techniques – Big-M tune –phase methods.

Unit 2:
Duality theorem – Dual simplex method – Sensitivity analysis - effect of changes in cost coefficients, Constraint constants, Addition/Deletion of variables and constraints

Unit 3:
Transportation problem – formulation – Initial basic feasible solution methods – Northwest, Least cost and Vogels methods, MODI optimization - Unbalanced and degeneracy treatment

Unit 4:
Assignment problem – Formulation – Hungarian method – Variants of assignment problems, Sequencing problems – Flow shop sequencing – n jobs×2 machines sequencing - n jobs×3 machines sequencing – Job-shop sequencing – 2 jobs×m machines sequencing – Graphical methods

Unit 5:
Game Theory - Introduction - Terminology – Saddle point games - with out Saddle point games - 2×2 games, analytical method - 2×n and m×2 games – graphical method – dominance principle

Unit 6:
Dynamic programming – Bellman's principle of optimality – short route – capital investment – inventory allocation

Unit 7:
Non linear optimization – Single variable optimization problem – Unimodal function - Elimination methods – Fibinocci and Golden reaction methods – Interpolation methods - Quadratic and cubic interpotation method.
Multi variable optimization problem – Direct research methods – Univariant method – Pattern search methods – Powell's , Hook-Jeaves and Rosen-brock's search method.

Unit 8:
Geometric programming – Polynomial – Arithmetic – Seametric inequality – Unconstrained G.P – Constraint G.P with ≤ type constraint.
Simulation: Definition – Types- steps- Simulation of simple electrical systems – Advantages and Disadvantages

TEXT BOOKS:
1. Optimization theory and Applications – S.S.Rao, New Age Internationals
2. Operations Research - S.D.Sharma, Galgotia publishers

3. Operations Research – Kausur and Kumar, Spinger Publishers

REFERENCES:

1. Optimization techniques: Theory and Practice – M.C.Joshi and K.M. More Ugalya, Narosa Publications
2. Optimization : Theory and Practice – Beweridze, Mc Graw Hill
3. Simulation Modelling and Analysis – Law and Kelton –TMH
4. Optimization Concepts and Applications in Engineering- A.D. Belegundu, J.R. Chandrupata, Pearson Education, Asia

NEURAL AND FUZZY SYSTEMS
(Elective – II)

Unit – I: Introduction to Neural Networks

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrateand- Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

Unit- II: Essentials of Artificial Neural Networks

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

Unit–III: Feed Forward Neural Networks

Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications.

Multilayer Feed forward Neural Networks

Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

Unit IV: Associative Memories

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem

Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network.

Unit V: Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART)

Introduction, Competitive Learning, Vector Quantization, Self-Organized Learning Networks, Kohonen Networks, Training Algorithms, Linear Vector Quantization, Stability-Plasticity Dilemma, Feed forward competition, Feedback Competition, Instar, Outstar, ART1, ART2, Applications.

Unit – VI: Classical and Fuzzy Sets

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT VII: Fuzzy Logic System Components

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT VIII: Applications

Neural network applications: Process identification, Function Approximation, control and Process Monitoring, fault diagnosis and load forecasting.

Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

TEXT BOOK:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication.

2. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.

REFERENCE BOOKS:

1. Neural and Fuzzy Systems: Foundation, Architectures and Applications, - N. Yadaiah and S. Bapi Raju, Pearson Education

2. Neural Networks – James A Freeman and Davis Skapura, Pearson, 2002.

3. Neural Networks – Simon Hykins , Pearson Education

4. Neural Engineering by C.Eliasmith and CH.Anderson, PHI

5. Neural Networks and Fuzzy Logic System by Bork Kosko, PHI Publications

ENERGY CONSERVATION SYSTEMS
(Elective – II)

1. Photo voltaic power generation ,spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, commercial photo voltaic systems, test specifications for pv systems, applications of super conducting materials in electrical equipment systems.

2. Principles of MHD power generation, ideal MHD generator performance, practical MHD generator, MHD technology.

3. Wind Energy conversion: Power from wind, properties of air and wind, types of wind Turbines, operating characteristics. Tides and tidal power stations, Modes of operation , tidal project examples, turbines and generators for Tidal power generation. Wave energy conversion: properties of waves and Power content, vertex motion of Waves, device applications. Types of Ocean thermal energy conversion systems Application of OTEC systems Examples, micro hydel developments.

4. Miscellaneous energy conversion systems: coal gasification and liquefaction, biomass conversion, geothermal energy, thermo electric energy conversion, fuel cells and batteries, principles of EMF generation, description of fuel cells, description of batteries, battery application for large powers.

5. Co-generation and energy storage, combined cycle co-generation, energy storage. Global energy position and environmental effects: energy units, global energy position.. Environmental effects of energy conversion systems, pollution from coal and preventive measures steam stations and pollution, pollution free energy systems.

TEXT BOOK

"Energy conversion systems" by Rakosh das Begamudre, New age international publishers, New Delhi - 2000.

POWER CONVERTERS LAB

1. Speed Measurement and closed loop control using PMDC motor

2. Thyristorised drive for PMDC Motor with speed measurement and closed loop control.

3. IGBT used single 4 quadrant chopper drive for PMDC motor with speed measurement and closed loop control.

4. Thyristorised drive for 1Hp DC motor with closed loop control.

5. 3 Phase input, thyristorised drive, 3 Hp DC motor with closed loop

6. 3 Phase input IGBT, 4 quadrant chopper drive for DC motor with closed loop control equipment.

7. Cycloconverter based AC Induction motor control equipment.

8. Speed control of 3 phase wound rotor Induction motor.

9. Single phase fully controlled converter with inductive load

10. Single phase half wave controlled converter with inductive load.