## UNIVERSITY DEPARTMENTS
ANNA UNIVERSITY CHENNAI  :  :  CHENNAI 600 025
REGULATIONS - 2009
CURRICULUM I TO IV SEMESTERS (FULL TIME)
M.E. POWER ELECTRONICS AND DRIVES

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**ELECTIVES FOR M.E. POWER ELECTRONICS AND DRIVES**

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## M.E. POWER ELECTRONICS AND DRIVES - PART TIME

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**TOTAL CREDITS TO BE EARNED FOR THE AWARD THE DEGREE = 67**
## ELECTIVES FOR M.E. POWER ELECTRONICS AND DRIVES

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### SEMESTER V

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<td>Modern Rectifiers and resonant Converters</td>
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<td>CO9151</td>
<td>Soft Computing Techniques</td>
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</table>
1. **ADVANCED MATRIX THEORY:**

2. **LINEAR PROGRAMMING**

3. **ONE DIMENSIONAL RANDOM VARIABLES**

4. **QUEUEING MODELS**

5. **COMPUTATIONAL METHODS IN ENGINEERING**

   \[ L + T: 45+15 = 60 \]

**BOOKS FOR REFERENCE:**
1. PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION
General expression of stored magnetic energy, co-energy and force/ torque – example using single and doubly excited system –Calculation of air gap mmf and per phase machine inductance using physical machine data.

2. REFERENCE FRAME THEORY

3. DC MACHINES
Voltage and torque equations – dynamic characteristics of permanent magnet and shunt DC motors – state equations - solution of dynamic characteristic by Laplace transformation.

4. INDUCTION MACHINES

5. SYNCHRONOUS MACHINES

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
1. SINGLE PHASE AC-DC CONVERTER  

2. THREE PHASE AC-DC CONVERTER  

3. DC-DC CONVERTERS  

4. AC VOLTAGE CONTROLLERS  

5. CYCLOCONVERTERS  

TOTAL : 45 PERIODS

TEXT BOOKS


REFERENCES


3.power electronics by vedam subramanyam
1. SINGLE PHASE INVERTERS

Introduction to self commutated switches: MOSFET and IGBT - Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – various harmonic elimination techniques – forced commutated Thyristor inverters.

2. THREE PHASE VOLTAGE SOURCE INVERTERS

180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques.

3. CURRENT SOURCE INVERTERS


4. MULTILEVEL INVERTERS

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

5. RESONANT INVERTERS

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

TOTAL: 45 PERIODS

TEXT BOOKS


REFERENCES

1. **INTRODUCTION**  

2. **SOLUTION OF FIELD EQUATIONS I**  
Limitations of the conventional design procedure, need for the field analysis based design, problem definition, solution by analytical methods-direct integration method – variable separable method – method of images, solution by numerical methods- Finite Difference Method.

3. **SOLUTION OF FIELD EQUATIONS II**  

4. **FIELD COMPUTATION FOR BASIC CONFIGURATIONS**  
Computation of electric and magnetic field intensities– Capacitance and Inductance – Force, Torque, Energy for basic configurations.

5. **DESIGN APPLICATIONS**  
Insulators- Bushings – Cylindrical magnetic actuators – Transformers – Rotating machines.

**REFERENCES**  
L=45: T=15, Total =60


5. User manuals of MAGNET, MAXWELL & ANSYS software.

1. DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS 9
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 – multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

2. 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.

3. 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.

4. 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 d.c drive.

5. DIGITAL CONTROL OF D.C 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.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
1. 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.

2. 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

3. 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

4. FIELD ORIENTED CONTROL


5. SYNCHRONOUS MOTOR DRIVES


TOTAL : 45 PERIODS

TEXT BOOKS


REFERENCES

1. SYNCHRONOUS RELUCTANCE MOTORS 9

2. 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.

3. SWITCHED RELUTANCE MOTORS 9
   Constructional features-principle of operation-Torque equation-Power Controllers-Characteristics and control Microprocessor based controller.

4. 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.

5. 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.

TOTAL : 45 PERIODS

TEXT BOOKS

3. LIM

REFERENCES

1. PIC 16C7X MICROCONTROLLER
Architecture memory organization – Addressing modes – Instruction set – Programming techniques – simple programs

2. PERIPHERALS OF PIC 16C7X
Timers – interrupts – I/O ports – I²C bus for peripheral chip access – A/D converter – UART

3. MOTOR CONTROL SIGNAL PROCESSORS
Introduction- System configuration registers - Memory Addressing modes - Instruction set – Programming techniques – simple programs

4. PERIPHERALS OF SIGNAL PROCESSORS
General purpose Input/Output (GPIO) Functionality- Interrupts - A/D converter-Event Managers (EVA, EVB)- PWM signal generation

5. APPLICATIONS OF PIC AND SIGNAL PROCESSORS
Voltage regulation of DC-DC converters- Stepper motor and DC motor control- Clarke’s and parks transformation-Space vector PWM- Control of Induction Motors and PMSM.

TOTAL : 45 PERIODS

TEXT BOOKS:


4. DSP based speed control of BLDC motor.

5. DSP based speed control of SRM motor.

6. Self control operation of Synchronous motors.

7. Condition monitoring of three-phase induction motor under fault conditions.

8. Re-programmable Logic Devices and Programming
   (a) VHDL programming – Examples
   (b) Verilog HDL programming – Examples
   (c) Realization of control logic for electric motors using FPGA.


10. Simulation of Automatic Voltage Regulation of three-phase Synchronous Generator.

11. Design of switched mode power supplies

   \[ P = 45 \quad \text{Total}= 45 \]

PE 9131  PROJECT WORK (PHASE I)  0  0  12  6

PE 9141  PROJECT WORK (PHASE – II)  0  0  24  12
1. STATE VARIABLE REPRESENTATION
Introduction-Concept of State-State equation for Dynamic Systems-Time invariance and linearity-Nonuniqueness of state model-State Diagrams-Physical System and State Assignment.

2. SOLUTION OF STATE EQUATION

3. CONTROLLABILITY AND OBSERVABILITY
Controllability and Observability-Stabilizability and Detectability-Test for Continuous time Systems- Time varying and Time invariant case-Output Controllability-Reducibility-System Realizations.

4. STABILITY

5. MODAL CONTROL
Introduction-Controllable and Observable Companion Forms-SISO and MIMO Systems-The Effect of State Feedback on Controllability and Observability-Pole Placement by State Feedback for both SISO and MIMO Systems-Full Order and Reduced Order Observers.

TOTAL : 45 PERIODS

REFERENCES:
CO9113  CONTROL SYSTEM DESIGN  

1. CONVENTIONAL DESIGN METHODS  
Design specifications- PID controllers and compensators- Root locus based design- Bode based design-Design examples  

2. DESIGN IN DISCRETE DOMAIN  
Sample and Hold-Digital equivalents-Impulse and step invariant transformations-Methods of discretisation-Effect of sampling- Direct discrete design – discrete root locus Design examples  

3. OPTIMAL CONTROL  
Formation of optimal control problems-results of Calculus of variations- Hamiltonian formulation-solution of optimal control problems- Evaluation of Riccati’s equation State and output Regulator problems-Design examples  

4. DISCRETE STATE VARIABLE DESIGN  
Discrete pole placement- state and output feedback-estimated state feedback-discrete optimal control- dynamic programming-Design examples  

5. STATE ESTIMATION  

TOTAL : 45 PERIODS  

REFERENCES  
1. INTRODUCTION

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

2. CURRENT CONTROLLED DEVICES

BJT’s – Construction, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power darlington - Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy – concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT & Thyristor.

3. VOLTAGE CONTROLLED DEVICES

Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT, FCT, RCT and IGCT.

4. FIRING AND PROTECTING CIRCUITS

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

5. THERMAL PROTECTION

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

TOTAL : 45 PERIODS

TEXT BOOKS


REFERENCES

1. INTRODUCTION
Reactive power control in electrical power transmission lines - Uncompensated transmission line - series compensation – Basic concepts of static Var Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified power flow controller (UPFC).

2. STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS

3. THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS

4. VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS

5. CO-ORDINATION OF FACTS CONTROLLERS

REFERENCES
1. INTRODUCTION
Introduction – Characterisation of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

2. NON-LINEAR LOADS
Single phase static and rotating AC/DC converters, Three phase static AC/DC converters, Battery chargers, Arc furnaces, Fluorescent lighting, pulse modulated devices, Adjustable speed drives.

3. MEASUREMENT AND ANALYSIS METHODS

4. ANALYSIS AND CONVENTIONAL MITIGATION METHODS
Analysis of power outages, Analysis of unbalance: Symmetrical components of phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers, Analysis of distortion: On–line extraction of fundamental sequence components from measured samples – Harmonic indices – Analysis of voltage sag: Detroit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI)– Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

5. POWER QUALITY IMPROVEMENT

TOTAL : 45 PERIODS

TEXT BOOKS
3. Power Quality - R.C. Duggan
5. Power electronic converter harmonics –Derek A. Paice
EB9121 COMPUTER AIDED DESIGN OF POWER ELECTRONIC CIRCUITS  L T P C 3 0 0 3

1. INTRODUCTION

2. ADVANCED TECHNIQUES IN SIMULATION

3. MODELING OF POWER ELECTRONIC DEVICES

4. SIMULATION OF CIRCUITS

5. CASE STUDIES

TOTAL : 45 PERIODS

REFERENCES
1. **PHASE PLANE ANALYSIS**

Concepts of phase plane analysis- Phase portraits- singular points- Symmetry in phase plane portraits- Constructing Phase Portraits- Phase plane Analysis of Linear and Nonlinear Systems- Existence of Limit Cycles.

2. **DESCRIBING FUNCTION**


3. **LYAPUNOV THEORY**


4. **FEEDBACK LINEARIZATION**


5. **SLIDING MODE CONTROL**

Sliding Surfaces- Continuous approximations of Switching Control laws- The Modeling/Performance Trade-Offs- MIMO Systems.

**TOTAL: 45 PERIODS**

**REFERENCES**

CO 9121 COMPUTER AIDED DESIGN OF INSTRUMENTATION SYSTEMS  L T P C  3 0 0 3

1. DATA ACQUISITION AND INSTRUMENT INTERFACE  9
   Programming and simulation of Building block of instrument Automation system –
   Signal analysis, I/O port configuration with instrument bus protocols - ADC, DAC,
   DIO, counters & timers, PC hardware structure, timing, interrupts, DMA, software
   and hardware installation, current loop, RS 232/RS485, GPIB, USB protocols,

2. VIRTUAL INSTRUMENTATION PROGRAMMING TECHNIQUES  9
   Block diagram and architecture of a virtual instrument, Graphical programming in
   data flow, comparison with conventional programming, Vis and sub-Vis, loops
   and charts, arrays, clusters and graphs, case and sequence structures, formula
   nodes, local and global variables, string and file I/O.

3. DESIGN TEST & ANALYSIS  9
   Spectral estimation using Fourier Transform, power spectrum, correlation
   methods, Stability analysis, Fault analysis –Sampling, Data Parity and error
   coding checks, Synchronization testing – Watch dog timer, DMA method – Real-
   time Clocking, Noise- Gaussian, White analysis

4. PC BASED INSTRUMENTATION  9
   Introduction – Evolution of signal standard – HART Communication protocol –
   Communication modes – HART networks – control system interface – HART
   commands – HART field controller implementation – HART and the OSI model

5. SIMULATION OF PHYSICAL SYSTEMS  9
   Simulation of linear & Non-linear models of systems, Hardware in loop simulation
   of physical systems using special softwares.

TOTAL : 45 PERIODS

REFERENCES:
   2002.
4. MAPLE V programming guide
5. MATLAB/SIMULINK user manual
6. MATHCAD/VIS SIM user manual.
7. LABVIEW simulation user manual
1. CLASSICAL CONTROLLER DESIGN: 9
Proportional(P)-Integral(I)-Derivative(D)-PI-PD - PID Controllers-Characteristics-Design-Controller Tuning- - Ziegler-Nichol’s method and cohen coon method – Damped oscillation method

2. STATE SPACE DESCRIPTION & DESIGN: 9
Review of state model for systems-state transition matrix –controllability-observability-Kalman decomposition-state feedback-output feedback-design methods-pole placement controller-full order and reduced order observers-dead beat control

3. NON LINEAR SYSTEMS: 9
Types of non-linearity-typical examples-describing function method-phase plane analysis-stability analysis of non linear systems- Lyapunov function – Construction of Lyapunov function- Lyapunov’s direct method- Lyapunov’s indirect method

4. OPTIMAL CONTROL: 9

5. DIGITAL CONTROL SYSTEMS: 9

TOTAL : 45 PERIODS

TEXT BOOKS:
3. Ogata” Modern Control Systems”

REFERENCES:
1. SUMMARY
Sources of EMI, Conducted and radiated interference- Characteristics - Designing for electromagnetic compatibility (EMC)- EMC regulation- typical noise path- use of network theory- methods of eliminating interferences.

2. HARDENING

3. BALANCING, FILTERING AND SHIELDING
Power supply decoupling- decoupling filters-amplifier filtering — high frequency filtering— shielding – near and far fields- shielding effectiveness- absorption and reflection loss, Shielding with magnetic material- conductive gaskets, windows and coatings- grounding of shields.

4. DIGITAL CIRCUIT NOISE AND LAYOUT

5. ELECTROSTATIC DISCHARGE, STANDARDS AND LABORATORY TECHNIQUES

TOTAL : 45 PERIODS

REFERENCES
1. INTRODUCTION

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Power coefficient-Sabinin's theory-Aerodynamics of Wind turbine

2. WIND TURBINES

HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction.

3. FIXED SPEED SYSTEMS

Generating Systems- Constant speed constant frequency systems -Choice of Generators-Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model-Generator model for Steady state and Transient stability analysis.

4. VARIABLE SPEED SYSTEMS

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modeling - Variable speed variable frequency schemes.

5. GRID CONNECTED SYSTEMS

Stand alone and Grid Connected WECS system-Grid connection Issues-Machine side & Grid side controllers-WECS in various countries

TOTAL : 45 PERIODS

REFERENCES


1. **DC POWER TRANSMISSION TECHNOLOGY**

   Introduction - Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system - Planning for HVDC transmission – Modern trends in DC transmission – DC breakers – Cables, VSC based HVDC.

2. **ANALYSIS OF HVDC CONVERTERS AND HVDC SYSTEM CONTROL**

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

   General principles of DC link control – Converter control characteristics – System control hierarchy - Firing angle control – Current and extinction angle control – Generation of harmonics and filtering - power control – Higher level controllers.

3. **MULTITERMINAL DC SYSTEMS**

   Introduction – Potential applications of MTDC systems - Types of MTDC systems - Control and protection of MTDC systems - Study of MTDC systems.

4. **POWER FLOW ANALYSIS IN AC/DC SYSTEMS**

   Per unit system for DC Quantities - Modelling of DC links - Solution of DC load flow - Solution of AC-DC power flow - Case studies.

5. **SIMULATION OF HVDC SYSTEMS**


**REFERENCES**

1. INTRODUCTION

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

2. ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION

Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

3. POWER CONVERTERS

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection Of inverter, battery sizing, array sizing
Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

4. ANALYSIS OF WIND AND PV SYSTEMS

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG and SCIG Based WECS-Grid Integrated solar system

5. HYBRID RENEWABLE ENERGY SYSTEMS

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV-Maximum Power Point Tracking (MPPT).

REFERENCES:


TOTAL : 45 PERIODS
1. MODELS FOR IDENTIFICATION


2. NON-PARAMETRIC AND PARAMETRIC IDENTIFICATION


3. NON-LINEAR IDENTIFICATION AND MODEL VALIDATION


4. ADAPTIVE CONTROL AND ADAPTATION TECHNIQUES


5. CASE STUDIES

Inverted Pendulum, Robot arm, process control application: heat exchanger, Distillation column, application to power system, Ship steering control.

TOTAL: 45 PERIODS

REFERENCES

3. Astrom and Wittenmark,” Adaptive Control “, PHI
1. **VHDL FUNDAMENTALS**

   Fundamental concepts- Modeling digital system-Domain and levels of modeling-modeling languages-VHDL modeling concepts-Scalar Data types and operations- constants and Variable-Scalar Types- Type Classification-Attributes and scalar types-expression and operators-Sequential statements.

2. **DATA TYPES AND BASIC MODELING CONSTRUCTS**

   Arrays- unconstrained array types-array operations and referencing- records - Access Types- Abstract Date types- -basic modeling constructs-entity declarations-Architecture bodies-behavioral description-structural descriptions-design Processing, case study: A pipelined Multiplier accumulator.

3. **SUBPROGRAMS , PACKAGES AND FILES**


4. **SIGNS, COMPONENTS, CONFIGURATIONS.**


5. **DESIGN WITH PROGRAMMABLE LOGIC DEVICES**

   Realization of -Micro controller CPU.- Memories-I/O devices-MAC-Design,synthesis,simulation and testing.

**TOTAL : 45 PERIODS**

**REFERENCES**

ET 9159                ADVANCED DIGITAL SIGNAL PROCESSING                   L T P C

1. INTRODUCTION                9
Mathematical description of change of sampling rate – Interpolation and Decimation, Filter implementation for sampling rate conversion – direct form FIR structures, DTFT, FFT, Wavelet transform and filter bank implementation of wavelet expansion of signals

2. ESTIMATION AND PREDICTION TECHNIQUES                         9

3. DIGITAL SIGNAL PROCESSOR               9
Basic Architecture – Computational building blocks, MAC, Bus Architecture and memory, Data Addressing, Parallelism and pipelining, Parallel I/O interface, Memory Interface, Interrupt, DMA.

4. APPLICATION OF DSP                9
Design of Decimation and Interpolation Filter, FFT Algorithm, PID Controller, Application for Serial Interfacing, DSP based Power Meter, Position control.

5. VLSI IMPLEMENTATION                            9
Basics on DSP sytem architecture design using VHDL programming, Mapping of DSP algorithm onto hardware, Realisation of MAC & Filter structure.

REFERENCES:

TOTAL : 45 PERIODS
EB 9152 APPLICATIONS OF MEMS TECHNOLOGY

1. MEMS: MICRO-FABRICATION, MATERIALS AND ELECTRO-MECHANICAL CONCEPTS
Overview of micro fabrication – Silicon and other material based fabrication processes – Concepts: Conductivity of semiconductors-Crystal planes and orientation-stress and strain-flexural beam bending analysis-torsional deflections-Intrinsic stress- resonant frequency and quality factor.

2. ELECTROSTATIC SENSORS AND ACTUATION
Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators-Applications

3. THERMAL SENSING AND ACTUATION
Principle, material, design and fabrication of thermal couples, thermal bimorph sensors, thermal resistor sensors-Applications.

4. PIEZOELECTRIC SENSING AND ACTUATION
Piezoelectric effect-cantilever piezo electric actuator model-properties of piezoelectric materials-Applications.

5. CASE STUDIES
Piezoresistive sensors, Magnetic actuation, Micro fluidics applications, Medical applications, Optical MEMS.

TOTAL : 45 PERIODS

REFERENCES
1. POWER SYSTEM HARMONICS & LINE COMMUTATED RECTIFIERS
Average power-RMS value of a waveform-Power factor-AC line current harmonic
standards IEC 1000-IEEE 519- The Single phase full wave rectifier-Continuous
Conduction Mode-Discontinuous Conduction Mode-Behaviour when C is large-
Minimizing THD when C is small-Three phase rectifiers- Continuous Conduction Mode-
Discontinuous Conduction Mode-Harmonic trap filters.

2. PULSE WIDTH MODULATED RECTIFIERS
Properties of Ideal rectifiers-Realization of non ideal rectifier-Control of current
waveform-Average current control-Current programmed Control- Hysteresis control-
Nonlinear carrier control-Single phase converter system incorporating ideal rectifiers-
Modeling losses and efficiency in CCM high quality rectifiers-Boost rectifier Example -
expression for controller duty cycle-expression for DC load current-solution for converter
Efficiency $\eta$.

3. RESONANT CONVERTERS
Review on Parallel and Series Resonant Switches-Soft Switching- Zero Current
Switching - Zero Voltage Switching -Classification of Quasi resonant switches-Zero
Current Switching of Quasi Resonant Buck converter, Zero Current Switching of Quasi
Resonant Boost converter, Zero Voltage Switching of Quasi Resonant Buck converter,
Zero Voltage Switching of Quasi Resonant Boost converter: Steady State analysis.

4. DYNAMIC ANALYSIS OF SWITCHING CONVERTERS
Review of linear system analysis-State Space Averaging-Basic State Space Average
Model-State Space Averaged model for an ideal Buck Converter, ideal Boost Converter,
ideal Buck Boost Converter, for an ideal Cuk Converter.

5. CONTROL OF RESONANT CONVERTERS
Pulse Width Modulation-Voltage Mode PWM Scheme-Current Mode PWM Scheme-
Design of Controllers: PI Controller, Variable Structure Controller, Optimal Controller for
the source current shaping of PWM rectifiers.

REFERENCES
1. Robert W. Erickson & Dragon Maksimovic” Fundamentals of Power Electronics”
2. William Shepherd and Li zhang” Power Converters Circuits”Marceld Ekkerin,C.
3. Simon Ang and Alejandro Oliva “Power- Switching Converters” Taylor & Francis
   Group
CO 9151 SOFT COMPUTING TECHNIQUES

1. INTRODUCTION


2. ARTIFICIAL NEURAL NETWORKS

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller

3. FUZZY LOGIC SYSTEM

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.

4. GENETIC ALGORITHM

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and and-colony search techniques for solving optimization problems.

5. APPLICATIONS


REFERENCES


TOTAL : 45 PERIODS