MEE 1103  ADVANCED DIGITAL SIGNAL PROCESSING

Module - 1
Introduction: Discrete time systems, Discrete time signals, Analysis of discrete-time linear time invariant systems, Difference equation description.

Module - 2

Module - 3
Frequency domain analysis, Discrete Fourier transform (DFT), Properties of DFT, Inverse DFT, Inter relationship with z-transform and Hilbert-transforms, Discrete Hilbert transform, FFT algorithms- Decimation in time and decimation in frequency.

Module - 4

Module - 5
Properties and design of FIR filters: Properties, Design techniques - window technique, Frequency sampling comparison of IIR and FIR filters.

Module - 6
Multirate digital signal processing, Introduction, Decimation by factor D, I sampling rate conversion by a rational factor I/D.

Module - 7
Introduction to continuous discrete and fast wavelet transforms.
Families of Wavelets: orthogonal and biorthogonal wavelets, Daubechies’ family of wavelets in detail.

Text Books:

Reference Book:
1. **Introduction**
   Systems, modelling, analysis and control, continuous-time and discrete-time.

2. **State Variable Descriptions**
   Introduction, concept of state, state equations for dynamic systems, state diagrams.

3. **Physical Systems & State Assignments**
   Linear continuous-time and discrete-time models, non-linear models, local linearisation of non-linear model.

4. **Solution of State Equations**
   Existence and uniqueness of solution, linear time-invariant continuous-time state equations, linear discrete-time state equations.

5. **Controllability & Observability**
   Concept of controllability & observability, controllability and observability tests for continuous-time systems, controllability and observability of discrete-time systems, canonical forms of state models.

6. **State models and input-output descriptions**
   Input-output maps from state model and vice-versa, transfer matrix, output controllability, reducibility.

7. **Modal Control**
   Introduction, Effect of state feedback on controllability and observability, pole placement by state feedback; Full order observers, Reduced-order observers; deadbeat control by state feedback, deadbeat observers.

8. **Fractional Order Controller**
   Fractional order calculus, Fractional order transfer function modelling, Frequency domain analysis of fractional order controller, Time domain analysis of time domain controller

**Books Recommended** :

1. Digital Control & State Variable Methods – M. Gopal, Tata Macgrow
2. Modern Control System Theory by M. Gopal
3. Linear Systems by Thomas Kailath.
Module - 1
Characteristics of modern semiconductor power devices: Gate Turn-off Thyristor (GTO), Power Bipolar Transistor, Power MOSFET, Insulated Gate Bipolar Transistor (IGBT), Static Induction Thyristor (SIT), FET-BJT Combination Switch, MOS-Controlled Thyristor, Power Integrated Circuit (PIC), Protection Circuit.

Module - 2
Linear voltage regulator: DC Voltage Regulator, Linear Regulator, Series Regulator, IC Voltage Regulator, 3-Terminal & 4-Terminal Negative Voltage Regulator, 4-Terminal Positive Regulator, Adjustable 3 and 4-Terminal Regulators, Dual Voltage Regulators, Current Regulator.

Module - 3

Module - 4
Resonant Converter: Basic Series Resonant Inverter, Series Resonant Inverters with Unidirectional Switches and Anti Parallel Diodes, Frequency-Domain Analysis of Series Resonant Converter, Parallel Link Capacitor Load Series Resonant Converter.

Module - 5
Frequency-Domain Analysis of Parallel Link Capacitor Load SRC, Quasi-Resonant Converter, Control Scheme for Zero Voltage Switching, Zero Current Switching, Quasi-Resonant Converter.

Module - 6

Module - 7
Transient Suppressors, Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI) and Their Suppression, Schematic Diagram of OFF-line and ON-line UPS Introduction to PLC and its application.

Text Book

References
Module - 1
INTRODUCTION
Optimal problem formulation, Design variables constraints, Objective function, Variable bounds, Engineering optimization problems, Optimization algorithms.

Module - 2
ONE DIMENSIONAL SEARCH METHODS
Optimality Criteria, Bracketing methods: Exhaustive search methods, Region - Elimination methods; Interval halving method, Fibonacci search method, Golden section search method, Point-estimation method; Successive quadratic estimation method.

Module - 3
Gradient-based methods: Newton-Raphson method, Bisection method, Secant method, Cauchy’s (Steepest descent) method and Newton’s method.

Module - 4
LINEAR PROGRAMMING
Graphical method, Simplex Method, Revised simplex method, Duality in Linear Programming (LP), Sensitivity analysis, other algorithms for solving LP problems, Transformation, assignment and other applications.

Module - 5
MULTIVARIABLE OPTIMIZATION ALGORITHM
Optimality criteria, Unidirectional search, Direct search methods: Simplex search method, Hooke-Jeeves pattern search method.

Module - 6
CONSTRAINED OPTIMIZATION ALGORITHM

Module - 7
ADVANCED OPTIMIZATION TECHNIQUES
Genetic Algorithm, Working principles, GAs for constrained optimization, Other GA operators, Advanced GAs, Differences between GAs and traditional methods. Simulated anneating method, working principles. Particle swarm optimization method, working principles.

Books Recommended:
4. Linear Programming – G. Hadley
Module - 1
Introduction: Background, uncertainty and imprecision, statistics and random processes, uncertainty in Information. Fuzzy sets and membership, chance versus ambiguity, fuzzy control from an industrial perspective, Knowledge based systems for process control, knowledge based controllers, knowledge representation in knowledge based controllers.


Module - 2
Membership Function: Features of membership functions, standard forms and boundaries, Fuzzyfication, Membership value assignment.
Fuzzy-to-Crisp conversions: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations. Defuzzification Methods

Module – 3

Module - 4
Multilayer Networks - Multilevel discrimination, preliminaries, backpropagation algorithm, setting the parameter values, Accelerating the learning process, Applications, RBF Network.

Module - 5
Unsupervised learnings - Winner take all networks, learning vector quantizers, ART, Topologically organised networks.
Associative Models - Non-iterative procedures for Association, hopfield networks,

Module - 6
Discussion of Neural Networks and Fuzzy Logic Application in areas of Power Electronics and motor control.

Text Books

References:
1. Elements of Artificial Neural Networks - Kishan Mehrotra, Chilakuri K. Mohan, Sanjay Ranka (Penvam International Publishing (India)
Module-I : Electrical vehicles:
Introductions, types of electrical vehicle, energy management in electrical vehicles, features, various subsystem in electrical vehicles. Future scopes

(7)

Module-II : Hybrid Electrical Vehicle:
Introduction, Types of hybrid electrical vehicle, series, parallel, series parallel and complex. According to hybridization- micro, mild and heavy HEV, mechanical power splitter and electrical power splitter, advantages and disadvantages, sizing of HEV, Power flow, Energy management,

(6)

Module-III: Introduction to Flexible AC transmission systems (FACTS)
Steady state and dynamic problems in AC systems - Principles of series and shunt compensation. Description of: static var compensation (SVC), Thyristor Controlled series compensators, (TCSC) - Static phase shifters (SPS) - Static condenser (STATCON)

(8)

Module-IV : Wind Energy Systems

(8)

Module-V: Photovoltaic Energy Conversion
Solar radiation and measurement - solar cells and their characteristics - influence of insulation and temperature - PV arrays - Electrical storage with batteries - solar energy availability in India - Switching devices for solar energy conversion, Maximum power point tracking. DC Power conditioning converters, AC power conditioners - Line commutated inverters - synchronized operation with grid supply

(8)

Module VI : HVDC Transmission
HVDC system control : CC and CEA controls, Static characteristics of converters, Combined characteristics of rectifier and inverter, Power reversal, Asynchronous & synchronous HVDC links, Frequency Control of A.C. system, Stabilisation & damping of A.C. networks, CP Control.


(5)

Books Recommended:
Understanding FACTS: concepts and technology of flexible AC transmission systems
2 Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice-Hall of India Private Ltd. New Delhi
1 **Introduction to Electrical Drives:**
Drive concepts, different machines & load characteristics, equilibrium and steady state stability, four quadrant operation, referred inertia and load torque for different coupling mechanism, thermal selection of machines

2 **DC Motor drives:**
Operating limits using armature voltage control and field control techniques, dynamic model (armature voltage control only) of machine and converters (continuous conduction only), open-loop dynamic performance, closed loop control using single (speed) and two loops (speed, current), implementation of four quadrant operation. modeling and control of separately excited dc machine in field weakening region and discontinuous converter conduction mode, design of close loop speed controller for separately excited dc motors.

3 **Induction motor drives:**
Review of scalar control methods (voltage, constant V/f & frequency) of three phase symmetrical Induction machines, speed control using current controlled VSI drives, close loop speed control with constant v/f control strategy, effects of harmonics and power factor.

4 **Vector control of Induction machines:**
Review of vector control, Implementation of direct & indirect vector control schemes, methods of flux estimation, effect of machine parameter variation on vector control performance, speed sensorless control, Direct Torque Control.

5 **Speed control of wound rotor induction machine:**
Static rotor resistance control, static Scherbius drive using line commutated converter cascade & cycloconverter, close loop speed control using slip power recovery, vector control of wound rotor induction machine using cyclo-converter, introduction to Variable Speed Constant Frequency (VSCF) generation.

6 **Control of synchronous machine:**
Wound field synchronous machine: Constant volts/Hz control, scalar self control (commutator less control), vector control. Control of permanent magnet synchronous machine: Brushless DC machine, surface permanent magnet machine.

7 **Control of Stepper Motors and Switch Reluctance Motors:**
Stepper motors operation, excitation table, control of stepper motor, operation of switched reluctance motor (SRM), expressions of torque, speed control of SRM.

**Books Recommended :**
- Fundamental of Electrical Drives: G K Dubey
- Modern Power Electronics & Drives: B K Bose
- Electric Motor Drives, modeling analysis and control: R Krishnan

Stable, unstable and chaotic systems; Examples from electrical, mechanical and fluid-dynamic systems.

Chaos in feedback systems. Types of attractions : Point, periodic, quasiperiodic and strange attractors. Pathways to chaos. Poincare section, Feigenbaum’s universality constants, Liapunov exponents.

Geometry of fractals; Chaotic dynamics on fractals; Hausdorff, correlation, information and Liapunov dimensions.

Characterization of attractors from experimental data. Basins of attraction and basin boundaries. Applications in engineering systems.

**Books Recommended:**
1. *Fractal Calculus (Defunct.Chaos & Dynamical Systems)* – Harrison
2. *Chaos* - Kathleen T. Alligood, Tim D. Sauer, and James A. Yorke
Module-I
**Basics of Simulation:** Block diagram, Transfer Function and State Variable representation of different mechanical and Electrical systems. Classification of systems as linear, nonlinear, continuous time and discrete time systems. (6)

Module-II
**Modeling and Simulation of phase controlled DC Converter:** Modeling and simulation of single-phase and three-phase AC to DC controlled converter with various load. Modeling and simulation of Buck converter, Boost Converter and Buck-Boost converter. (6)

Module-III
**Simulation of DC Drives:** Simulation tools and their application in DC drive simulation. Open-loop control of DC motor. Close-loop control of DC Motor. Design of P, PI and PID controller. PWM techniques for DC applications. (6)

Module-IV
**Simulation of phase controlled AC Drives:** Modeling and simulation of variable voltage variable frequency ac drives, speed control using constant flux, constant slip control. PWM based induction motor drives. (5)

Module-V
**Modeling of Different PWM techniques for inverter:** Sine-triangle PWM for single and three phase converter. Modelling and simulatios of Space vector PWM, Modeling of Three-level inverter, SPWM techniques for multi-level inverter. (5)

Module-VI
**Modeling and simulation of vector controlled AC drives:** Direct field oriented current control, direct field oriented voltage control, and indirect field oriented methods. Modeling and imulation of vector controlled induction motor drives, direct torque control of induction motors drives. (8)

Module-VII
Modeling and simulation of Synchronous motor drives: Transient models, simulation of three-phase synchronous machines, simulate the permanent magnet synchronous motor, linearized analysis of synchronous generator under various values of field flux, mechanical loading and inertia. (8)

Books Recommended:
1. Dynamic Simulation of Electric Machinery using Matlab/Simulink-Chee-Mun Ong
2. Low power Electronics design – Christian Piguet
3. Modern Power Electronics & Drives-B.K.Bose
4. Electromagnetic modeling of power electronic converters – J A Ferreira
5. Electric Motor Drives, modelling analysis and control- R. Krishnan
MEE 2151 ADVANCED DSP ARCHITECTURE AND PROGRAMMING

Module I
**DSP Development System:** Introduction to DSP, Example of DSP system A to D signal conversion, DSP support tools, code composer studio, compiler, assembler and linker, input and output with the DSK

Module II
**Architecture of C6x Processor:** Introduction TMS320 C6x architecture, functional units, fetch and execute packets, pipe lining, registers, Linear and circular addressing modes

Module III
**Instruction Set of C6x Processor:** Instruction set assembly directives, linear assembly, ASM statement within C, timers, interrupts, multi channel buffering serial ports, direct memory access, memory consideration, fixed and floating points format, code improvement and constraints.

Module IV
**Real Time FIR Filtering:** Design of FIR filter, FIR lattice structure, FIR implementation using fourier series, windows function, programming examples using C language.

Module V
**Real Time IIR Filtering:** Design of IIR filter, IIR lattice structure, impulse invariance, bilinear transformation programming examples using C language.

Module VI
**Fast Fourier Transform:** Introduction, DIT FFT algorithm with Radix 2, DIF FFT algorithm with Radix 2, inverse fast fourier transform, fast convolution, programming example using C language.

Module VII
**DSP/BIOS and RTDX Using MATLAB & Lab VIEW:** Introduction to DSP/BIOS, RTDX using MATLAB provide interface between PC and DSK, RTDX using Lab VIEW provide interface between PC and DSK.

Books Recommended:
1. Digital signal processing and applications with C6713 and C6416 DSK by Rulph Chassaing, wiley publication.
2. Real-Time digital signal processing based on the TMS320C6000 by Nasser Kehtarnavaz, ELSEVIER publication
3. DSP applications using C and the TMS320c6x DSK by Rulph Chassaing, wiley publication.
Module – 1

Module – 2
Solar Energy: Solar thermal Systems: Types of collectors, Collection systems, efficiency calculations, applications. Photo voltaic (PV) technology: Present status, solar cells, cell technologies, characteristics of PV systems, equivalent circuit, array design, building integrated PV system, its components, sizing and economics. Peak power operation, Solar tracking system, Standalone and grid interactive systems.

Module – 3
Wind Energy: Wind speed and power relation, power extracted from wind, wind distribution and wind speed predictions. Wind power systems: system components, Types of Turbine, Turbine rating Choice of generators, turbine rating, electrical load matching, Variable speed operation, maximum power operation, control systems, system design features, stand alone and grid connected operation.

Module – 4

Module – 5
Hydro energy: Feasibility of small, mini and micro hydel plants scheme layout economics. Tidal and wave energy, Geothermal and Ocean-thermal energy conversion (OTEC) systems – schemes, feasibility and viability.

Module – 6

Module – 7
Grid Integration: Grid integration with the system: Interface requirements, Stable operation, Transient-safety, Operating limits of voltage, frequency, stability margin, energy storage, and load scheduling.

Books Recommended:
2. Energy Technology – S. Rao, Parulkar

Reference Books:
1. Wind and solar systems by Mukund Patel, CRC Press.
3. Wind Energy Technology – Njenkins, John Wiley & Sons
MEE 2115  EMBEDDED SYSTEM AND APPLICATIONS

MODULE – I
Introduction: Embedded Systems Overview, Processor technology- General purpose processors (Software), Single purpose processors (Hardware), Application- Specific processors; IC Technology- Full-custom/VLSI, Semicustom ASIC (Gate Array and standard cell), PLD, etc. (5)

MODULE – II
Basic Concepts of Computer Architecture: Concepts, Memory, Input/ Output, DMA, Parallel and Distributed computers, Embedded Computer Architecture, etc. (5)

MODULE – III

MODULE – IV
FPGA: Xilinx XC3S400 FPGA Architecture, XC9572 CPLD Architecture, VHDL Programming (VHDL Synthesis) (5)

MODULE – V
dsp-based controllers: Texas Instrument’s TMS320C6713 DSP processor: Introduction, Major features, Architecture, Application and programming. (5)

MODULE – VI & VII

Text Books:
3. Douglas Perry, “VHDL Programming by Example”, TMH publication
5. Mazidi & Mazidi, "AVR Microcontrollers & Embedded Systems using Assembly & C ", Pearson Education

Reference Books:
1. Design and selection of passive and active components:
   Design of low power single phase step down transformers, inductors (choke) and filter
circuits, Selection of switching devices for specific applications, Design of snubber circuit
for them. (9)
Ref: Power Electronics: essentials and applications - L Umanand, Microchip SMPS AC/DC
Reference Design, User’s Guide,

2. Design of Driver circuits and commutation circuits:
   Driver circuits for Thyristor, BJT, MOSFET/IGBT, design of commutation circuits for
forced commutated converter, selection of current, voltage and speed sensor for complete
close loop system design. (5)
Ref: Power Electronics: essentials and applications - L Umanand

3. AC/DC converter design:
   Diode based single phase half & full converter, Three-phase converter, Thyristor based half
and full converter, selection of power components & filter design, different schemes for
firing circuits.
Ref: Power Electronics: essentials and applications - L Umanand, (7)

4. DC/DC switched mode converter design:
   Design of chopper based Buck converter, Boost converter, Buck-Boost converter; Isolated
converter, Flyback converter, Schemes for firing circuits. (6)
Ref: Power Electronics: essentials and applications - L Umanand,

5. DC/AC converter design:
   Single phase half, full and three phase square wave inverters, Three phase Voltage source
inverter, Fourier analysis of output voltage waveform, selection of active and passive
components and their ratings, Design of firing circuit. (5)
Ref: Power Electronics: essentials and applications - L Umanand

6. Switched mode power supply design:
   System specification, Block diagram of SMPS, Design of PFC booster, Full bridge zero
voltage transition converters, Single and three phase synchronous buck converter, Auxiliary
power supply etc. (6)
and applications - L Umanand,

7. Thermal design:
   Thermal problems in power electronics, Understanding of General thermal flow process,
Design of heat sink, selection of cooling techniques. (5)
Ref: Power Electronics: essentials and applications - L Umanand.