# 2nd Semester

## ED-551 MICROCOMPUTER CONTROLLED DRIVES

DC Drives - Converter fed DC Drives, Microcontroller hardware circuit, flow charts waveforms, Performance characteristics of dc drives fed through single phase converters, 3-phase converters, dual converters, 1-phase fully controlled converter and 3-phase fully controlled converter fed dc drive,
Chopper fed DC Drives, hardware, circuits and waveforms., various modes of operation

Performance Characteristic Of AC Drives - Description and Performance behaviour of 3-phase induction motor drive
Microcomputer controlled inverter fed ac drive - Detailed power circuit, generation of firing pulses and firing circuit, flow charts and waveforms for 1-phase, 3-phase non pwm and 3-phase pwm inverter fed induction drives. Sampling techniques for pwm inverter.

Mathematical modeling of frequency controlled drive - Development of mathematical model for various components of frequency controlled induction drive, mathematical model of the system for steady state and dynamic behaviour, Study of stability based on the dynamic model of the system.

Close loop control of microcomputer based drives - Ref. speed, actual speed digital speed measurement (various methods). Types of controllers, position and velocity algorithm, close loop control of microcomputer based Drives.

**References:**


1. Power semiconductor controlled drives, Dubey G.K., Prentiee-HALL 1989
2. Power electronics and variable frequency drives, Bose B.K., IEEE Press 1997
3. Control of electric drives, Leonard W, Springer Verlag, NY,1985
4. Microcomputer control of power electronics and drive, Bose B.K.
5. Adjustable a.c. drive, Bose B.K.
6. Thyristor control of Electronic drive, V.Subramanyam

## ED-552 ADVANCED CONTROL SYSTEM

DESIGN AND COMPENSATION TECHNIQUES :
The Design Problem, Preliminary design considerations. Basic comparators, cascade compensation in time domain and frequency domain, feedback compensation, Different types of controllers.

STATE VARIABLE ANALYSIS :
State variables, state space representation, Transfer matrix, state model for linear continuous time systems. Eigen values, eigen vectors, Diagonalization, Solution of state equation, concept of controllability and observability. Pole placement by state feedback.

DISCRETE TIME SYSTEMS :
Introduction to discrete time systems , Time domain, representation & transformation analysis of discrete time systems, time domain approach and z domain approach. Pulse transfer function, Controllability and observability of discrete time systems stability analysis in z plane.

NON LINEAR CONTROL SYSTEMS :
Introduction, characteristics limit cycles, singular points, Basic non linear components phase plane methods, Describing functions, Definition, D.F. for basic non linearities, Absolute stability, circle and popov criterion, Liapunov functions.

LINEAR OPTIONAL AND ADAPTIVE CONTROL :
Linear optimal regulator problem, finite time horizon, Principle of optimality, Hamilton Jacobi equation, Riceati differential equation, steady state solutions (LQR), Algebraic Riceati equation, properties, gain and phase margin, sensitivity, non linearities, optimal state estimation, Kalman filter, Output feedback control (LQG).

**Reference Books** :

1. Digital Control Engineering - M.Gopal
2. Adaptive and Optimal Control - A.P.Sage & Landue
3. Optimal Control - A.P.Sage
4. Discrete Time Control System - Katsuniko Ogata
5. Modern Control Engineering – Nagarth Gopal

## ED-553 INSTRUMENTATION IN ELECTRICAL DRIVES

Review of Transducers - Introduction, measurement of translational and rotational displacement. Resistive potentiometers, strain gauges; differential transformer, synchros, induction potentiometers, piezoelectric transducer; Electro-optical devices, Digital displacement transducers (Translational and rotary encoders).Magnetic and photoelectric pulse counting for speed. Transducers for Torque voltage; current; power; frequency; power factor; and phase angle measurement.

Signal Conditioning - Necessity, Instrumentation amplifiers, chopper stabilized amplifiers, Impedance converters, Noise problems, shielding and grounding.
Concept of filters; Low pass filters; high pass filters; band pass filters ;band rejection filters; digital filters. Integration and differentiation of signals, Dynamic compensation, Linearisation, Concept of A/D and D/A Converters (voltage to frequency and frequency to voltage converter) sample/hold amplifiers, Microprocessor applications in signal conditioning.

Data Transmission And Recording- Cable transmission of analog voltage and current signals, cable transmission of digital data, Fiber optic data transmission, FM/FM radio telemetry, synchroposition repeater systems.

Microprocessor Based Measurement Of Electrical Quantities - Microprocessor based measurement of frequency, phase angle; power factor; voltage; current; reactance; resistance; KVA; KW; KWh and KVAR

Computerised Data Acquisition System - Elements of data acquisition systems, data loggers, instrument interconnection systems; Block diagram and details of computerized data acquisition systems Instrumentation schemes for close loop control of Dc drives and AC drives.

**Reference Books**:


1. Measurement systems, Application and Design by Ernest O.Docbelin.
2. Electrical and electronic measurement by A.K.Shawney.
3. Fundamental of microprocessor and microcomputers by B.Ram.

## ED-554 TRACTION DRIVES

Electric Traction Systems, Mechanics of Train movement, speed time curves, preliminary investigations of energy consumption, and ideal speed torque characteristics of Traction motors.

Constructional and Design aspects of DC single phase and 3-phase I.Ms for Electric traction ,constraints and comparison w.r.t. commercial machines, problem associated with voltage rises. Temporary Interruption of supply, commutation of current rush, Ability of motors to withstand current rushes.

Solid-state device controllers for DC Traction motors used for starting, speed control and electric braking in Electric traction for main line and suburban services.

Controllers for 1-phase Traction motors, trends in main line railways using polyphase I.Ms and their controllers. Electric braking requirements and thyristorised controllers.

Battery operated vehicles for city service, Light weight batteries, Diesel-Electric Traction systems for main line service and controllers.
Soft starting of Traction motors, Conservation of Electrical energy.

**Reference Books :**


1. Electric Traction by A.T.Dover
2. Thyristorised Power Controllers by G.K.Dubey, Dorodla, Joshi& Sinha.
3. Power Electronics by M.S.Berde.
4. Modern Electric Traction by Prakash.

## ED-561 ELECTIVE II

## ADVANCE POWER ELECTRONICS

DC-DC Switch Mode converter- Control of DC - DC Converter. BUCK, BOOST, BUCK-BOOST Converters etc.

P.W.M. Converter- PWM Techniques, Current controlled techniques, High Power Factor Converters.

Resonant Converters - Classification, Concepts, Load-Resonant Converters, Resonance-Switch Converters, Zero voltage Switching.

Power Supplies - Linear Power Supplies, Overview of Switching DC Power Supply, Control and Protection of SMPS.

Switching Mode Inverters - Basic concept, 1-Φ, 3-Φ Inverters Switching, Schemes and applications.

**Reference Books** :


1. Power Electronics – Ned Mohan
2. Power Electronics – M. H. Rashid
3. Power Electronics – M. D. Singh
4. Power Electronics – Joseph Vithythal
5. Power Electronics – Philip Kranes
6. Power Electronics – G. K. Dubey

## ED-562 ELECTIVE II

## EVOLUTIONARY TECHNIQUES

MODELS
Model classification, Mathematical models, Physical Models, Analog Models, Estimation of Model parameters, Design of experiments, System Identification.

SIMULATION METHODOLOGY & COMPUTER SIMULATION
Experimental Nature of Simulation, Steps involved in simulation studies, Validation of Simulation Models, Computer Simulation of continuous & discrete systems; examples.

NEURAL NETWORKS
Introduction, different network configurations (MLP, Hopfield, Kohonen etc.), Feedforward and recurrent networks, Training algorithms – static error back propagation technique and dynamic training algorithms, Computer flow charts for training, NNW applications for control, identification, pattern recognition and system modeling & state estimation.

FUZZY LOGICS
Concept, Fuzzy relations, membership functions, if-then-rules, matrix representation, defuzzification, fuzzy controllers, applications.

GENETIC ALGORITHMS
Introduction and concept, schemata, coding, reproduction, cross-over, and mutation, scaling, fitness, applications. Neuro-fuzzy networks, Genetic algorithm in fuzzy controllers, other hybrid applications.

**Reference Books :**


1. Geoffery Gordon, System Simulation, Prentice Hall India, 1998
2. Robert E.Shannon, Systems Simulation : Art and Science, Prentice Hall
3. J.M.Zurada, Introduction to Artificial Neural System, Jaico Publ. House, Bombay, 1994
4. G.W.Irwin, K.Warwick & K.J.Hunt[Editors], Neural Network Application in Control, Instn of Elect. Engrs, U.K., 1995
5. D.T.Pham & L.Xing, Neural Networks for Identification, Prediction and Control, Springer-Verlag, London, 1995
6. V.Rao & H. Rao, C++ Neural Networks and Fuzzy Logic, BPS, Delhi, 1996
7. D.E.Goldberg, Genetic Algorithms in Search, Optimization, and machine learning, Addision Wesley Publ. Co. INC, NY.