

SEMESTER-VIII

DRIVES & CONTROL (EE 8134)

Details of PWM inverter fed ac drives with different forms of feedback control, bang-band and sliding mode structures, realization on microcomputer based systems. Scalar and Vector control of ac motor, flux estimators and their shortcomings, hardware realization, start up control of induction motors with PWM and flux vector structures. Present day shortcoming of inverter fed induction motor drives-bearing erosion, shaft fracture and efficiency problems involvement of soft switching inverters and impact on ac drive performance SR motors and PM motors drive control. Basic Aspects of Design of Power Electronic Modules and Microprocessor Controllers.

INTELLIGENT CONTROL (EE 8135)

Conventional control review , Feedback linearization , Robust and adaptive control , Fuzzy system : Introduction to fuzzy logic , Examples , fuzzy logic based identification and control , adaptive fuzzy control , Neural networks : Basics , Neural network based identification and control of nonlinear systems , examples . Various other soft computing techniques for control applications . Introduction to reinforcement learning.

List of Elective for Eighth Semester:

- 1. DSP BASED CONTROL OF ELECTRIC DRIVE (EE 8136)**
- 2. UTILIZATION AND TRACTION (EE 8137)**
- 3. POWER QUALITY & RELIABILITY (EE 8138)**
- 4. MECHATRONICS (EE 8139)**
- 5. HIGH VOLTAGE ENGINE RING (EE 8140)**
- 6. INTELLIGENT INSTRUMENTATION (EE 8141)**
- 7. POWER ELECTRONICS APPLICATIONS IN POWER SYSTEM (EE 8142)**
- 8. IDENTIFICATION TECHNIQUES AND ADAPTIVE CONTROL (EE 8143)**
- 9. POWER SYSTEM DYNAMICS AND CONTROL (EE 8144)**
- 10. COMPUTER ORGANISATION & ARCHITECTURE (EE 8145)**
- 11. HVDC TRANSMISSION (EE 8146)**
- 12. INTELLIGENT ALGORITHMS FOR POWER SYSTEMS (EE 8147)**
- 13. MODELING AND ANALYSIS OF ELECTRICAL MACHINES (EE 8148)**
- 14. BIOMEDICAL INSTRUMENTATION (EE 8149)**
- 15. NEURAL NETWORKS & FUZZY SYSTEM (EE 8150)**
- 16. VLSI DESIGN (EC 7111)**
- 17. EMBEDDED SYSTEM DESIGN (EE 8151)**
- 18. COMPUTER VISION (CS 7118)**

1. DSP BASED CONTROL OF ELECTRIC DRIVE (EE 8136)

Features of DSP in comparison to those of ordinary processors, computational advantage handicaps regarding analog & digital interface. Communication advantages, harmonic analysis in real time using a DSP specific assembly language features for a DSP. On chip RAM & external RAM I/O interface. PWM & firing pulse generation through a typical DSP, look-up tables & real time computation. Interfacing & actuation circuits for DSP based controllers. Realization of computationally intensive algorithms like variable structure, adaptive & neural network schemes for drive systems.

2. UTILIZATION AND TRACTION (EE 8137)

1. Industrial Drives:

Characteristics of Electrical Motors and their Particular application for Industrial Drives. Motor Enclosures, Bearing, transmission of Drives, Choice of Motor, Motors used for Lifts, Cranes and General Purpose Machines, Typical application in Sugar, Textile, Paper and Steel Industries, Motors used in Mining Operations, Rating of Electric Motors, Calculation of size load equation of flywheels Electric breaking: Plugging, Dynamic and regenerative breaking, breaking current torque, speed time curves (number of revolutions made before stop)

2. Traction:

electric traction, general features, traction motors and their characteristics controller and auxiliary equipment, system of railway electrification, trade remittance tractive effort, speed time curves, energy consumption, modern trends in electrical trades.

3. Heating and Welding:

Electric heating, resistance evens, temperature control, induction heating, principles and applications, high frequency induction heating, inductance furnaces by electric heating

4. Illumination:

Sources of light, incandescent & fluorescent lamps, lighting fittings, reflection factor, illumination, calculation, solid angle, candle power, units of light and illumination, power curves, M.H.C.P. AND M.S.C.P.

Illumination level and its measurement coefficient of utilization, waste light factor, illumination calculations for building and playgrounds, flood lighting, industrial lighting, street lighting

5. Electrolytic process and motor control circuit

3. POWER QUALITY & RELIABILITY (EE 8138)

Overview and definition of power quality (PQ) and reliability, Sources of pollution, international power quality standards, and regulations, Power quality problems: rapid voltage fluctuations, voltage unbalance, voltage dips and voltage swells, short duration outages

Power system harmonics: harmonic analysis, harmonic sources- the static converters, transformers magnetization and non- linearities, rotating machines, arc furnaces,

fluorescent lighting, Harmonic effects-within the power system, interference with communication Harmonic measurements. Harmonic elimination- harmonic filters. Power system reliability evaluation: Static generation capacity reliability evaluation, Operational generation capacity reliability evaluation, Inter connected power system reliability evaluation.

4. MECHATRONICS (EE 8139)

Mechatronics :

Definitions and terminology , its elements such as mechanics , electronics , microelectronics , power electronics and information technology. Mechanical elements with integrated electronics suspension systems , vibration dampers , clutches , bearing mechanical or magnetic , gears etc. Machines with integrated electronics , electric drives pneumatic and hydraulic drives , water steam or gas turbines , combustion engines , etc. Generators , pumps , compressors , machines tools , robots , printing machines , vehicles : automobiles , ships and aircrafts . Precision machines with integrated electronics devices for telecommunication , consumer electronics , data processing devices , sensors , actuators , optical devices and medical devices , power electronics converters.

5. HIGH VOLTAGE ENGINEERING (EE 8140)

Breakdown in gases :

Mechanisms of breakdown in gases, various related ionization processes. Townsends and streamer theories. Paschen's law, Breakdown in non-uniform fields. Effect of wave shape of impressed voltage on the breakdown strength. Breakdown of sphere gap and rod gap.

Breakdown in liquid and solids :

Mechanisms of breakdown in liquids, suspended particle, suspended water, cavitation and bubble and electronic breakdown theories. Mechanisms of breakdown in solids; intrinsic electro-mechanical, erosion, surface, thermal and streamer, relation between electric strength of solids and time, intrinsic breakdown strength.

Impulse Generator:

Specification of an impulse voltage wave, standard impulse, reasons for adopting the particular shape, analysis and control of simple circuit of impulse generator. Multistage impulse generator(marks circuit) circuit-working, earthing and tripping. Techniques to observe wave front on C.R.O.

Generation of high voltage :

Methods of generation of power frequency high voltage cascade transformers and resonance methods, generation of high voltage D.C., voltage stabilization. Tesla coil.

Measurement of high voltage :

Potential dividers-resistive, capacitive and mixed dividers for high voltage. Sphere gap; construction, mounting, effect of nearby earthed objects, humidity and atmospheric conditions, effect of irradiation and polarity, electrostatic voltmeter; principle and

classification, constructional details of an absolute electrostatic voltmeter. Oscilloscopes and their applications in high voltage measurement.

High Voltage Testing :

Measurement of insulation resistance of cables. Wet and dry flashover test of insulators. Testing of insulators in simulated polluted conditions. Testing of transformers and rotating machines. Measurement of breakdown strength of oil. Basic techniques of non-destructive testing of insulators; measurement of loss angle, high voltage Schering bridge, and partial discharge measurement techniques.

Over Voltage and Insulation Coordination :

Lighting, switching and temporary over voltages, BIL, SIL, Methods of insulation coordination.

6. INTELLIGENT INSTRUMENTATION (EE 8141)

Introduction, data flow and graphical programming techniques, virtual instrumentation (vi), advantages, vis and sub vis, data acquisition methods, DAQ hardware; structure, operating systems, ISA, PCI, USB, PCMCIA buses. IEEE 488.1 and IEEE 488.2, serial interfacing- RS 232C, RS 422, RS 423, CAMAC, VXI, SCXI, PXI, sensors and transducers; interfacing signal conditions, signal analysis technique, networking methods and their applications in instrumentation.

7. POWER ELECTRONICS APPLICATIONS IN POWER SYSTEM (EE 8142)

Basics of flexible ac transmission, controlled rectifier and energy storage, plants, tap changers and phase shifters, thyristors controlled VAR compensation and series compensation, modern (synchronous link converter) VAR compensators, unified power flow control (UPFC) and interline power flow controller, power quality conditioners, power electronics in power generation.

8. IDENTIFICATION TECHNIQUES AND ADAPTIVE CONTROL (EE 8143)

Review of stochastic process. Models & model classification. The identification problem, some fields of applications. Classical methods of identification of impulse response & transfer function models, model learning technique, linear least square estimator, properties of ISE, generalized & weighted least square, instrumental variable method. On the identification using recursive least squares, minimum variance algorithm, stochastic approximation & maximum likelihood method. Simultaneous state & parameter estimation extended Kalman filter, two stage identification methods. Nonlinear identification, model reference adaptive control.

9. POWER SYSTEM DYNAMICS AND CONTROL (EE 8144)

Introduction to power stability problems, models of: synchronous machines, excitation systems, prime mover & governor, loads. Transient stability analysis, dynamic stability analysis. Dynamic equivalents, stabilizers, levels of power system control, AGC, SCADA & computer control.

10. COMPUTER ORGANISATION & ARCHITECTURE (EE 8145)

Organization of a computer: von Neumann & Harvard architecture; instruction set architecture; RISC & CISC PROCESSORS, computer arithmetic; fixed point & floating point arithmetic; design of ALU; hardware algorithms for addition, multiplication & division of fixed point & floating point numbers, processor design; data path & control design, microprogramming, exception programming, pipelining, memory organization, memory hierarchy, cache organization, virtual memory, system design, bus architecture, bus transactions; input-output systems; programmed I/O, DMA & interrupt driven I/O. illustrations with examples of CISC processors from Intel & RISC processors like MIPS & ARM.

11. HVDC TRANSMISSION (EE 8146)

Comparison of HVAC & HVDC transmission, HVDC transmission schemes, component description, and converter: principles, characteristics, control circuits, HVDC system control, protection, harmonics & filters, AC-DC system interaction, AC-DC load flow.

12. INTELLIGENT ALGORITHMS FOR POWER SYSTEMS (EE 8147)

Introduction of artificial neural networks (ANN), multilayer feed forward networks, back propagation training algorithm, radial basis function & recurrent networks. ANN based algorithms for: load flow analysis, economic load dispatch, load forecasting, transient stability, & power system stabilizers. Introduction to genetic algorithms.

13. MODELING AND ANALYSIS OF ELECTRICAL MACHINES (EE 8148)

Energy state functions, modeling of electro mechanical systems. Matrix method & use of generalized circuit theory of machines. Different methods of transformation, phase variable instantaneous symmetrical component techniques, Development of basic performance equation & analysis of different rotating machines such as D.C., synchronous & induction machines, Dynamics & transients in electric machines. Switching transients & surges, Transient & short circuit studies on alternators, run-up re-switching & other transients in induction machines, relevant computer techniques for machine analysis. Modeling of special electrical machines

14. BIOMEDICAL INSTRUMENTATION (EE 8149)

Introduction to physiology of cardiac, nervous & muscular and respiratory systems. Transducers and Electrodes: Different types of transducers & their selection for biomedical application, Electrode theory, selection criteria of electrodes & different types of electrodes such as Hydrogen Calomel, Ag- AgCl, pH, etc.

Cardiovascular measurement: The heart & the other cardiovascular systems. Measurement of Blood pressure, Blood flow, Cardiac output and cardiac rate. Electrocardiography, phonocardiography, Ballistocardiography, Plethysmography, Magnet- cardiography, Cardiac pacemaker & computer applications.

Respiratory System Measurement: Respiratory Mechanism, Measurement of gas volumes & flow rate. Carbon dioxide and Oxygen concentration in inhaled air. Respiratory controllers.

Measurement of Electrical Activities in Muscles and Brain: Electroencephalograph, Electromyograph & their interpretation.

Instrumentation for clinical laboratory: Measurement of pH value of Blood, ESR measurements, Haemoglobin measurements, Oxygen & carbon dioxide concentration in Blood, GSK measurements, polarographic measurements, Computer applications.

Medical Imaging: Ultra sound imaging Radiography & applications.

Biotelemetry: Transmission & reception aspects Biological signals. Aspects of patient care monitoring.

15. NEURAL NETWORKS & FUZZY SYSTEM (EE 8150)

Introduction to artificial neural network

Neural Networks: History, overview of biological Neuro- system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning paradigms –Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms- perceptions, Training rules, Delta, Back propagation Algorithm, Multilayer perceptron Model, Applications of Artificial Neural Networks.

Competitive learning networks, Kohonen self organizing networks, Hebbian Learning; Hopfield Networks, Associative Memories, The boltzman machine; Applications.

Fuzzy Logic: Introduction to Fuzzy Logic, classical and Fuzzy Sets: Overview Of Classical Sets, Membership Function, Fuzzy rule generation. Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations. Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations . Fuzzy Logic: Classical Logic.

16. VLSI DESIGN (EC 7111)

Analog VLSI circuit Design

- 1) Review of MOSEFT characteristics, scaling and small- geometry effects, MOSEFT capacitances.
- 2) MOS Resistor, MOS current source, current circuit. MOS voltage source linear voltage and current converters.
- 3) CMOS operational amplifier (OPAMP) design: Differential amplifier, level shifter, source follower, output stage voltage and power amplifiers. Cascade OPAMP. Compensation techniques.
- 4) Analog Filters: Switched capacitor (SC) fundamentals, First order SC circuits, second-order SC circuits and cascade design.
- 5) Analog to digital and digital to analog converters, speed of conversion and over sampling issues.
- 6) VSLI Interconnects: Distributed RC model, Transmission line model, Future inter connect technology.

Digital VLSI Circuit Design

- 1) MOS inverters, CMOS inverter, state characteristics, switching characteristics, power dissipation issues.
- 2) CMOS Logic gates: NAND, NOR, XOR, CMOS logic design of half and full adders. CMOS transmission gates, Pseudo-NMOS, domino logic gates.
- 3) Sequential MOS Logic Circuit: The SR latch circuit, Clocked latch and flip-flop, CMOS D-latch and edge – triggered circuits, Schmitt trigger circuit, Comparator.
- 4) Dynamic Logic Circuit: Pass transistor logic synchronous dynamic circuit techniques.
- 5) Semiconductor Memories: ROM circuits, SRAM circuits, DRAM circuits, Drivers and buffers, Buffer scaling and design issues.

CAD Tools for VLSI Design:

- 1) SPICE: Element lines, Control lines, Command lines, Types of analysis, models and model parameters, Sub circuit and Macros.
- 2) Layout design rules Layout of inverters, NAND, NOR gates using LASI

17. EMBEDDED SYSTEM DESIGN (EE 8151)

Embedded Computing: Introduction, Complex systems and Microprocessors, The embedded system design process, Formalization for system design.

Instruction Sets CPU: Instruction and preliminaries ARM and SHARC Processors, Programming I/O CPU performance and power consumption.

The embedded Computing Platform and program design: Introduction, the CPU bus, Component interfacing, designing in with microprocessors, development and debugging.

Program Design and Analysis: Introduction program design, Assembly, Linking, Basic compilation techniques, and Analysis optimization of executive time.

18. COMPUTER VISION (CS 7118)

Digital image fundamentals: elements of digital image processing system, elements of visual perception image model, digital image representation, basic relations between pixels, image geometry. Image model, digital image representation basic relations between pixels, image geometry. Image Transforms: Introduction to fourier transform, discrete fourier transform, fast fourier transform, other seperable image transforms. Image Enhancement: Spatial and Frequency – domain methods. Histogram-modification techniques, Image smoothing, Image sharpening by differentiation/high pass filtering. Image Restoration: Degradation model, algebraic approach to restoration, inverse filtering, LMS filter restorations, Interactive restoration, Restoration in spatial domain. Image Encoding: Fidelity of discontinuities, Edge linking and boundary detection, Thresholding, Representation and Description: Schemes, Boundary descriptors, Regional descriptors, Description of similarities, Relational descriptors. Image Data Compression: Introduction, Pixel coding, Predictive techniques, Transform coding theory, hybrid coding and vector DPCM.