Instrumentation Control I & IInd

Instrumentation and Control : Paper-I

Basic Circuit Analysis :

Kirchoff's Laws – DC and AC circuits, Mesh and Nodal analysis for DC and AC circuits; Thevenin's, Norton, Superposition and maximum power transfer theorem; Magnetically coupled circuits; Transient response of RL, RC and RLC circuits. Characterization of two networks, Three phase circuits-balanced and unbalanced, phasor diagram of voltages and currents.

Electronic Devices and Circuits:

Diode, BJT, JFET, MOSFET-Structure, operation and Characteristics; LED,Laser Diode, Zenor diode-characteristics; Amplifiers-Small signal model analysis of CE, CB, CC amplifiers, gain and frequency response, multistage amplifiers, differential amplifiers; feedback amplifiers and oscillators; A/D and D/A converters, Boolean algebra, logic gates, design of arithmatric circuits, flip-flops, counter and shift registers.

Digital Signal Processing:

Classification of signals-continuous and discrete; energy and power, mathematical representation of signals; classification of system-continuous, discreate, linear, causal, time variance, stable, dynamic, spectral density, aliasing effect; Analog fitter design, bilinear transformation, Discrete Fourier Tansform, FIR and IIR fitter realization.

Basic Instrumentation Engineering:

Introduction to instruments and their representation, Functional elements of measurement system, classification of instruments, standards and calibration, measurement system performance static characteristics-Error analysis, loading effect, Dynamic characteristics.

Transdueers and Smart Sensors:

Classification of transducers, selection of transducers, characteristics of transducers, mathematical model of transducers-zero, first and second order transdueers response to impulse, step, ramp and sinusoidal inputs, variable resistance, inductance and capacitance transducers; LVDT, strain gauges

temperature transducers construction, characteristic and applications; capacitive and piezoelectric transducers – frequency response, Hall effect transducers, photo detectors, digital transducer; smart sensors, fibre-optic sensors, MEMS, Nano Sensors.

Industrial and Analytical Instrumentation:

Pressure, flow, temperature, liquid level- Principle of Operation, installation and maintenance; calibration, measurement of force, torque, velocity, vibration, humidity, viscosity and density; spectrophotometers (UV and IR); pH meters, conductivity meters; Analysers (O_2, NO_2, H_2S), Chromatography, NMR spectroscopy, X-ray spectres copy and mass spectrometer.

Microprocessor and Microcontroller :

8085 and 8086 processor – Hardware, architecture, pinouts, functional building blocks of processor, memory organization, I/O parts and data transfer concepts, timing diagrams. Programming of 8085 Processor; 8051 Microcontroller-Hardware Architecture, pinouts-Functional building blocks, I/O parts and data transfer concepts, timing diagram, Interupts, Comparison to Programming Concepts with 8085, Peripheral Interfacing-Study and need, architecture, configuration and interfacing with ICs 8255, 8259, 8254, 8237, 8251, 8279; A/D and D/A converter interfacing with 8085 and 8051; Microcontroller Programming and applications-Data transfer, Manipulation, Control Algorithm and I/O Instructions-Simple programming exercises, key board and display interface – closed loop control of servo motors, stepper motor control, washing machine control.

Instrumentation and Control : Paper-II

Control Systems :-

Open and closed loop systems, mathematical modeling of physical systems, Electrical analogy of mechanical and thermal systems, transfer function – Synchros, AC and DC servomotors – block diagram reduction techniques, signal flow graphs, Time response, time domain specifications, types of test input; first and second order system response, error efficient, steady state error; Root locus construction, Effects of P, PI, PID modes of feedback control, time response analysis, Frequency response – Bode Plot, polar plot, Correlation between frequency domain and time domain specifications – Effects of Lag, lead and lag-Lead compensation on frequency response; stability and compensator design – Characteristic equation, Routh-Hurwitz Criterion; Nyquist stability Criterion, state variable analysis , concept of state variables, solution of state and output equation in controllable canonical form – concepts of controllability and observability.

Power Electronics :-

Power Semiconductor devices – Study of switching devices, Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT – Static and dynamic characteristics – triggering and commutation circuit for SCR, Design of driver and snubber circuit; Phase controlled converters – 2-pulse, 3-pulse and 6-pulse converters; Gate circuit schemes for phase control – dual converters, DC to DC Converters – Step-up and Step-down Chopper Control strategy; force commutated chopper; voltage commutated, currant commutated, load commutated, switched mode regulators – Buck, boost, buck-boost converters, AC to DC Converters, Inverters – single phase and three phase inverters.

Electrical Machines and Drives :-

DC machines – generators – construction, principle of operation, types, emf equation, open circuit, Internal and external characteristics. DC motors – principle of operation – back emf, need for a starter. Single phase transformers – construction, principle of operation, phasor diagram, losses, SC and OC test, efficiency and regulation. AC Machines – 3 Phase induction motor – Construction and principle of operation, torque-slip characteristics. Synchronous machines – Alternator and motor – Construction, operation and applications. Single phase induction motors. DC drives and AC drives. DC and AC servomotor, synchros, stepper motor – Construction and working

Process Control Instrumentation:-

Introduction to process control : Process control block diagram – control system evaluation, Signal conditioning (analog). Final control operation – signal conversion (analog to digital), Actuators (electrical, pneumatic and hydraulic) – Control elements (mechanical, electrical and fluid valves). Discrete state Process Control; Characteristics of the system, discrete state variables, process specifications. Controller principles: Process characteristics – control system parameters – discontinuous controller modes – two position, multiposition, floating control mode, Controller modes – Proportional, Integral and derivative Control mode. Analog controller, computer based control. Pneumatic controllers.

Control loops : control system configurations – dead time process – Capacity, describing functions, dead Zone, Dead band, Cascade control, Feed forward control – load balancing, steady – state model, ratio control, inverse Control. Process loop turning : Control system quality. Process loop tuning – closed loop method, ultimate method (Ziegler Nichols method), damped oscillater method, process reaction curve method, frequency response method, comparing turning method.

Logic and Distributed System :-

Components of PLC – advantages over relay logic – architecture of PLC – Programming devices; discrete and analog I/O modules, programming languages – ladder diagram, programming timers and conters, design of PLC, Program control instruction, math instructions, sequence instructions : Use of PC and PLC, application of PLC, SCADA – data acquisition system, supervisory control, direct digital control, DCS – architecture, comparison, local control unit, Process interfacing issues, communication facilities, operator interfaces – low level and high level operator interfaces, operator displays, engineering interfaces – low level and high level engineering interfaces.