

CONTROL & INSTRUMENTATION ENGINEERING - SYLLABUS

- i. **Electrical Circuits:**
Voltage and current sources- Inductor, mutual inductor and capacitor- transient analysis of RLC circuits with dc excitation. Peak-, average- and rms values of ac quantities; apparent-, active- and reactive powers; phasor analysis, impedance and admittance; series and parallel resonance, locus diagrams, realization of basic filters with R, L and C elements.
Kirchoff's laws, Thevenin, Norton, maximum power transfer and reciprocity theorems. One-port and two-port networks, driving point impedance and admittance, open-, and short circuit parameters.
- ii. **Signals and Systems:**
Periodic, aperiodic and impulse signals; Laplace, transfer function, impulse response, frequency response, pulse transfer function; DFT; IIR and FIR filters.
- iii. **Control Systems:**
Feedback principles, signal flow graphs, transient response, steady-state-errors, Bode plot, phase and gain margins, Routh and Nyquist criteria, root loci, design of lead, lag and lead-lag compensators, statespace representation of systems- time-delay systems; mechanical, hydraulic and pneumatic system components, synchro pair, servo and stepper motors, servo valves; on-off, P, P-I, P-I-D, cascade, feed forward, and ratio controllers.
- iv. **Analog Electronics:**
Characteristics and applications of diode, Zener diode, BJT; small signal analysis of transistor circuits, feedback amplifiers. Characteristics of operational amplifiers; applications of opamps: difference amplifier, adder, subtractor, integrator, differentiator, instrumentation amplifier, active filters. Oscillators, signal generators, voltage controlled oscillators and phase locked loop.
- v. **Digital Electronics:**
Combinational logic circuits, minimization of Boolean functions. IC families: TTL and CMOS. Arithmetic circuits, comparators, Schmitt trigger, multi-vibrators, sequential circuits, flip- flops, shift registers, timers and counters- sample-and-hold circuit, multiplexer, analog-to- digital (successive approximation, integrating, flash and sigma-delta) and digital-to- analog converters (weighted R, R-2R ladder and current steering logic). Characteristics of ADC and DAC (resolution, quantization, significant bits, conversion/settling time); basics of number systems, 8-bit microprocessor and microcontroller: applications, memory and input-output interfacing; basics of data acquisition systems.
- vi. **Measurements:**
SI units, systematic and random errors in measurement, expression of uncertainty. Measurement of voltage, current and power in single and three phase circuits; ac and dc current probes; true rms meters, voltage and current scaling, instrument transformers, timer/counter, time, phase and frequency measurements, digital voltmeter, digital multimeter; oscilloscope, shielding and grounding.
- vii. **Sensors and Industrial Instrumentation:**
Resistive-, capacitive-, inductive-, piezoelectric-, Hall effect sensors and associated signal conditioning circuits; transducers for industrial instrumentation: displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (differential pressure, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor)- liquid level, pH, conductivity and viscosity measurement.

viii. **Communication and Optical Instrumentation:**

Amplitude and frequency modulation and demodulation; Shannon's sampling theorem, pulse code modulation-frequency and time division multiplexing, amplitude-, phase-, frequency-, pulse shift keying for digital modulation; optical sources and detectors: LED, laser, photo-diode, light dependent resistor and their characteristics- interferometer-applications in metrology-basics of fiber optic sensing.

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