

ELECTRICAL ENGINEERING

Electrical Circuits—Theory and Applications :

Circuit components, network graphs, KCL, KVL; circuit analysis methods: nodal analysis, mesh analysis; basic network theorems and applications; transient analysis : RL, RC and RLC circuits; sinusoidal steady state analysis; resonant circuits and applications; coupled circuits and applications; balanced 3-phase circuits. Two port networks, driving point and transfer functions; poles and zeros of network functions.

Signals & Systems :

Representation of continuous-time and discrete-time signals & systems; LTI systems; convolution; impulse response; time-domain analysis of LTI systems based on convolution and differential/difference equations. Fourier transform, Laplace transform, Z-transform, Transfer function. Sampling and recovery of signals.

Control Systems :

Elements of control systems; block-diagram representations; open-loop & closed-loop systems; principles and applications of feed-back. LTI systems : time domain and transform domain analysis. Stability : Routh Hurwitz criterion, root-loci, Nyquist's criterion Bode-plots, Design of lead-lag compensators; Proportional, PI, PID controllers.

E-M Theory :

Electro-static and magneto-static fields; Maxwell's equations; e.m. waves and wave equations; wave propagation and antennas; transmission lines; micro-wave resonators, cavities and wave guides.

Electrical Engineering Materials :

Electrical/electronic behaviour of materials : conductivity; free-electrons and band-theory; intrinsic and extrinsic semi-conductor, p-n junction; solar cells, super-conductivity. Dielectric behaviour of materials : polarization phenomena; piezo-electric phenomena. Magnetic materials: behaviours and application.

Analog Electronics :

Diode circuits: Rectifiers filters, clipping and clamping, zener diode and voltage regulation. Bipolar and field effect transistors (BJT, JFET and MOSFET) : Characteristics, biasing and small signal equivalent circuits. Basic amplifier circuits; differential amplifier circuits. Amplifiers : analysis, frequency response. Principles of feedback; OPAMP circuits; filters; oscillators.

Digital Electronics :

Boolean algebra; minimisation of Boolean functions; logic gates, digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinational circuits : arithmetic circuits, code converters, multiplexers and decoder's. Sequential circuits : latches and flip-flops, counters and shift-registers. Comparators, timers, multivibrators. Sample and hold circuits; ADCs and DACs. Semi-conductor memories.

Communication Systems :

Fourier analysis of signals : amplitude, phase and power spectrum, auto-correlation and cross-correlation and their Fourier transforms. Analog modulation systems : amplitude and angle modulation and demodulation systems, spectral analysis; superheterodyne receivers. Pulse code modulation (PCM), differential PCM, delta modulation. Digital modulation schemes : amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK). Multiplexing : time-division, frequency-division. Additive Gaussian noise : characterization using correlation, probability density function, power spectral density, Signal-to-noise ratio calculations for AM and FM. Elements of digital communication systems : source coding, channel coding; digital modulation & demodulation. Elements of Information theory, channel capacity. Elements of satellite and mobile communication; principles of television engineering; radar engineering and radio aids to navigation.

Computers and Microprocessors :

Computer organization : number representation and arithmetic, functional organization, machine instructions, addressing modes, ALU, hardwired and microprogrammed control, memory organization. Elements of microprocessors. 8-bit microprocessors -architecture, instruction set, assembly level programming, memory, I/O interfacing, microcontrollers and applications.

Measurement and Instrumentation :

Error analysis; measurement of current voltage, power, energy, power-factor, resistance, inductance, capacitance and frequency; bridge measurements. Electronic measuring instruments: multimeter, CRO, digital voltmeter, frequency counter, Q-meter, spectrum-analyser, distortion-meter. Transducers: thermocouple, thermistor, LVDT, strain-gauges, piezo-electric crystal. Use of transducers in measurements of non-electrical quantities. Data-acquisition systems.

Energy Conversion :

Single-phase transformer : equivalent circuit, phasor-diagram, tests, regulation and efficiency; three-phase transformer; auto transformer. Principles of energy conversion-d.c. generators and motors : performance characteristics, starting and speed control, armature reaction and commutation; three-phase induction motor: performance characteristics, starting and speed control. Single-phase induction motor. Synchronous generators : performance characteristics, regulation, parallel operation. Synchronous motors : starting characteristics, applications; synchronous condenser. FHP motors, permanent magnet and stepper motors, brushless d.c. motors, single-phase motors.

Power Systems :

Electric power generation : thermal, hydro, nuclear. Transmission line parameters : steady-state performance of overhead transmission lines and cables. Distribution systems : insulators, bundle conductors, corona and radio interference effects; per-unit quantities; bus admittance and impedance matrices; load flow; voltage control and power factor correction. Economic operation. Principles of overcurrent, differential and distance protection; solid state relays, circuit breakers, concept of system stability. HVDC transmission.

Power Electronics and Electric Drives :

Semiconductor power devices : diode, transistor, thyristor, triac, GTO and MOSFET, static characteristics, principles of operation; triggering circuits; phase controlled rectifiers; bridge converters—fully controlled and half controlled; principles of thyristor chopper and inverter. Basic concept of speed control of dc and ac motor drives.

Elements of IC Fabrication Technology :

Overview of IC Technology. Unit steps used in IC fabrication : wafer cleaning, photo-lithography, wet and dry etching, oxidation, diffusion, ion-implantation, CVD and LPCVD techniques for deposition of poly-silicon, silicon, silicon-nitride and silicon dioxide; metallisation and passivation.