

Part B - Syllabus

ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)

Circuit Theory: KVL and KCL; mesh and node analysis; Thevenin, Norton, Superposition, and Maximum Power Transfer theorems; AC circuit analysis: phasors, impedance, power factor; resonance (series and parallel); two-port networks: Z, Y, ABCD, and h parameters; transient analysis of RL, RC, and RLC circuits; Laplace transform in circuit analysis; network topology; graph theory.

Electromagnetic Fields: Coulomb's and Gauss's laws; electric potential and energy; capacitance; Biot-Savart and Ampere's laws; Faraday's law and Lenz's law; inductance; Maxwell's equations in integral and differential forms; displacement current; electromagnetic wave propagation; polarisation; reflection and refraction; Poynting vector and power flow.

Electrical Machines: DC machines: construction, principles, EMF equation, torque-speed characteristics, starting and braking methods; transformers: equivalent circuit, phasor diagrams, efficiency and voltage regulation, three-phase connections, tap changers; induction motors: slip, torque-speed characteristics, equivalent circuit, starting methods; synchronous machines: EMF equation, synchronous reactance, V-curves, power-angle characteristics, synchronising and steady-state stability; special machines: stepper, servo, and BLDC motors.

Power Systems: Per-unit analysis; transmission line models: short, medium, and long lines; power flow: Gauss-Seidel and Newton-Raphson methods; economic operation of power systems; load frequency control; reactive power compensation; fault analysis: symmetrical and unsymmetrical faults using symmetrical components; power system stability: swing equation, equal area criterion; protective relaying: overcurrent, differential, distance relays; high-voltage DC (HVDC) transmission.

Control Systems: Open- and closed-loop systems; transfer functions; signal flow graphs; Mason's formula; block diagram reduction; time-domain analysis: transient and steady-state response, error constants; frequency-domain analysis: Bode plot, Nyquist criterion, gain and phase margins; root locus design; compensator design: lead, lag, PID; state-space representation; controllability and observability; Lyapunov stability.

Power Electronics: Power semiconductor devices: diode, SCR, MOSFET, IGBT — characteristics and gate drives; rectifiers: half-wave, full-wave, single-phase and three-phase, with and without filters; DC-DC converters: buck, boost, buck-boost, and Cuk; inverters: single-phase and three-phase, PWM techniques; AC voltage controllers; cycloconverters; power factor correction; FACTS devices; electric drives: DC and AC motor drives.

Digital Systems and Microprocessors: Number systems and Boolean algebra; combinational circuits: adders, multiplexers, encoders, decoders; sequential circuits: flip-flops, registers, counters; memory devices; 8085/8086 architecture and instruction set; interfacing: ADC, DAC, timers, and serial communication; microcontrollers: 8051 and ARM Cortex; assembly language programming; interrupt handling and DMA.

Signals and Systems: Continuous-time and discrete-time signals; LTI systems: convolution and impulse response; CTFT, DTFT, DFT, and FFT; Laplace transform; Z-transform; sampling theorem and signal reconstruction; FIR and IIR filter design; spectral analysis; correlation; random signals and noise; power spectral density.

Measurements and Instrumentation: Measurement errors and standards; bridges: Wheatstone, Kelvin, Maxwell, Schering; PMMC, MI, and electrodynamic instruments; CRO and signal

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generators; strain gauges, thermocouples, RTDs, and LVDTs; transducers for pressure, flow, and level; signal conditioning; data acquisition systems; virtual instrumentation; smart sensors and IoT.

Analog Electronics: Diode circuits: clippers, clammers, and rectifiers; BJT and MOSFET amplifiers: biasing, small-signal analysis, frequency response; op-amp circuits: inverting/non-inverting, integrators, differentiators, summing amplifiers, comparators; oscillators: Barkhausen criterion, Colpitts, Hartley, RC phase shift; active filters; voltage regulators; 555 timer applications.

Renewable Energy Systems: Solar photovoltaic systems: cell models, I-V characteristics, MPPT techniques, grid-tied and standalone systems; wind energy systems: wind turbine aerodynamics, power electronics interface; fuel cells: types and applications; energy storage: batteries, supercapacitors, and flywheels; smart grids and distributed generation; energy efficiency and demand side management; power quality issues.