



Punyashlok Ahilyadevi Holkar Solapur University, Solapur

PET 10

Ph.D. Entrance Test Syllabus for Paper-II

Electrical Engineering Syllabus

Unit 1: Electrical Machines and Control Systems

Transformers: Single-phase transformer: equivalent circuit, phasor diagram, open-circuit and short-circuit tests, regulation and efficiency. Three-phase connections, auto-transformer.

DC Machines: Separately excited, shunt and series machines; characteristics; starting and speed control.

Induction Machines: Three-phase induction motor: equivalent circuit, torque–slip characteristics, no-load and blocked-rotor tests, starting and speed control.

Synchronous Machines: Cylindrical-rotor machine: phasor diagram, voltage regulation, parallel operation; salient-pole machine (basic).

Control Systems: Transfer function, block diagrams, signal-flow graphs; transient and steady-state analysis; Routh–Hurwitz criterion; root locus; Bode plot and Nyquist criterion; lag and lead compensators, PID controllers; state-variable models (basic).

Unit 2: Networks, Signals and Electromagnetic Fields

Circuit Analysis: KCL, KVL, nodal and mesh analysis; network theorems; sinusoidal steady state, phasors, complex power; resonance; transient response of RL, RC and RLC circuits; two-port networks; balanced three-phase circuits.

Signals and Systems: LTI systems: causality, stability, impulse response and convolution; Fourier series and Fourier transform; Laplace transform; sampling theorem; Z-transform (basic).

Electromagnetic Fields: Coulomb's law, Gauss's law, electric field, potential and capacitance; Biot–Savart's law, Ampere's law, Faraday's law; inductance; magnetic circuits; Maxwell's equations (basic).

Unit 3: Power Systems, Power Electronics and Drives

Power Systems: Transmission-line parameters, models and performance; per-unit system; bus-admittance matrix; load flow using Gauss–Seidel and Newton–Raphson methods (basic); voltage and frequency control; economic load dispatch (without losses).

Faults, Protection and Stability: Symmetrical components; symmetrical fault analysis; over-current, differential and distance protection; circuit breakers; power-system stability and equal-area criterion.

Power Electronics: V–I characteristics of power diode, thyristor, MOSFET and IGBT; DC–DC buck, boost and buck–boost converters; single-phase and three-phase controlled rectifiers; single-phase and three-phase voltage-source inverters, sinusoidal PWM.

Electric Drives: Four-quadrant operation; speed control of DC motors using controlled rectifiers and choppers; speed control of induction motors (stator voltage, V/f control); electric braking.

Unit 4: Electrical Measurements and Electronics

Electrical Measurements: Measurement of voltage, current, power, energy and power factor; bridges; instrument transformers; digital multimeters; oscilloscopes; error analysis.

Analog Electronics: Diode circuits (clipping, clamping, rectifiers); BJT and MOSFET biasing and amplifiers; op-amp circuits (amplifiers, summers, integrators, differentiators, active filters, Schmitt trigger, 555 timer).

Digital Electronics and Data Converters: Boolean algebra, K-map minimization; combinational circuits (multiplexers, decoders); sequential circuits (flip-flops, counters, shift registers); sample-and-hold, ADC and DAC.