GATE

Syllabus

Electronics & Communication Engineering (ECE)

8 Sections | Complete Topic-wise Breakdown

Contents

Section 1 – Engineering Mathematics

■ Linear Algebra

Vector space, basis, linear dependence and independence, matrix algebra, eigen values and eigen vectors, rank, solution of linear equations – existence and uniqueness.

■ Calculus

Mean value theorems, theorems of integral calculus, evaluation of definite and improper integrals, partial derivatives, maxima and minima, multiple integrals, line, surface and volume integrals, Taylor series.

■ Differential Equations

Linear differential equations, Euler-Cauchy equation, Nonhomogeneous equations, methods of solution using variation of parameters, complementary function and particular integral, partial differential equations, variable separable method, initial and boundary value problems.

■ Vector Analysis

Vectors in plane and space, vector operations, gradient, divergence and curl, Gauss's, Green's and Stokes' theorems.

■ Complex Analysis

Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, sequences, series, convergence tests, Taylor and Laurent series, residue theorem.

■ Probability and Statistics

Mean, median, mode, standard deviation, combinatorial probability, probability distributions, binomial distribution, Poisson distribution, exponential distribution, normal distribution, joint and conditional probability, correlation and regression analysis.

Section 2 – Networks, Signals and Systems

■ Circuit Analysis

Node and mesh analysis, superposition, Thevenin's theorem, Norton's theorem, reciprocity. Sinusoidal steady state analysis: phasors, complex power, maximum power transfer.

■ Time and Frequency Domain Analysis

Time and frequency domain analysis of linear circuits: RL, RC and RLC circuits, solution of network equations using Laplace transform. Linear 2-port network parameters, wye-delta transformation.

■ LTI Systems

Definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay.

■ Continuous-time Signals

Fourier series and Fourier transform, Nyquist sampling theorem, sampling and reconstruction.

■ Discrete-time Signals

DTFT, DFT, z-transform, FIR and IIR filter design.

Section 3 – Electronic Devices

■ Energy Bands

Formation of energy bands in solids, energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors.

■ Carrier Transport

Diffusion current, drift current, mobility and resistivity, generation and recombination of carriers, Poisson and continuity equations.

■ Devices

P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, scaling in MOSFETs, LED, photo diode and solar cell.

Section 4 – Analog Circuits

■ Diode Circuits

Clipping, clamping and rectifiers.

■ BJT and MOSFET Amplifiers

Biasing, AC coupling, small signal analysis, frequency response. Current mirrors and differential amplifiers.

■ Op-amp Circuits

Amplifiers, summers, differentiators, integrators, active filters, Schmitt trigger and oscillators, dominant-pole (Miller) compensation, phase margin.

Section 5 – Digital Circuits

■ Number Representations

Binary, integer and floating-point numbers.

■ Combinatorial Circuits

Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders.

■ Sequential Circuits

Latches and flip-flops, counters, shift-registers, finite state machines, propagation delay, setup and hold time, critical path delay.

■ Data Converters

Sample and hold circuits, ADCs and DACs.

■ Semiconductor Memories

ROM, SRAM, DRAM.

■ Computer Organization

Machine instructions and addressing modes, ALU, data-path and control unit, instruction pipelining.

Section 6 – Control Systems

■ Core Topics

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; compensators, PID controller; State variable model and solution of state equation of LTI systems.

Section 7 – Communications

■ Random Processes

Autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems.

■ Analog Communications

Amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, super heterodyne receivers.

■ Information Theory

Entropy, source coding, mutual information and channel capacity theorem.

■ Digital Communications

PCM, DPCM, digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth, intersymbol interference, MAP, ML detection, matched filter receiver, SNR and BER. Fundamentals of error correction, Hamming codes, CRC.

Section 8 – Electromagnetics

■ Maxwell's Equations

Differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector.

■ Plane Waves and Properties

Reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth.

■ Transmission Lines

Equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart. Rectangular and circular waveguides, light propagation in optical fibers, dipole and monopole antennas, linear antenna arrays.