

Entrance Test Syllabus

for Ph.D

in

Electronics & Communication Engineering

(2025)

Unit 1: Engineering Mathematics and Transforms

- Linear algebra: matrix operations, eigenvalues, Cayley-Hamilton theorem.
 - Differential equations, Laplace and Fourier transforms, Z-transform.
 - Partial differentiation, maxima/minima of multivariable functions.
 - Probability theory: Bayes' theorem, random variables, binomial, Poisson, normal distributions.
 - Fourier series, harmonic analysis, convolution theorem and applications in signals.
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Unit 2: Network Theory and Signals

- Circuit elements: RLC circuits, Kirchhoff's laws, mesh/nodal analysis.
 - Network theorems: Thevenin, Norton, Superposition, maximum power transfer.
 - Two-port networks: Z, Y, h, ABCD parameters; interconnections.
 - Network functions, resonance, filters (constant-k, m-derived).
 - Classification of signals and systems, time and frequency domain analysis.
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Unit 3: Analog Electronic Circuits

- Diodes: characteristics, rectifiers, regulators, clipping/clamping circuits.
 - BJT and FET operation, biasing, small-signal models, multistage amplifiers.
 - Feedback amplifiers: topologies, stability, frequency response.
 - Differential amplifiers, current mirrors, active loads, IC biasing.
 - Power amplifiers (Class A/B/AB/D), oscillators, waveform generators.
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Unit 4: Digital Systems and VLSI

- Number systems, Boolean algebra, logic minimization (K-map, Quine-McCluskey).
 - Combinational circuits: MUX, DEMUX, encoder, decoder, adder/subtractor.
 - Sequential circuits: flip-flops, counters, shift registers, state machines.
 - Memory: ROM, RAM, FPGA, CPLD, PLA, PAL basics.
 - VHDL fundamentals, modeling of digital systems, RTL design flow.
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Unit 5: Signals and Systems

- Time-domain analysis: convolution, system properties (LTI, causality, stability).
 - Fourier and Laplace transforms, frequency response, filter design.
 - Sampling theorem, aliasing, CTFT and DTFT.
 - Z-transform: properties, system analysis, region of convergence.
 - State-space analysis and solution of differential equations.
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Unit 6: Digital Signal Processing (DSP)

- Discrete-time signals and systems, convolution, difference equations.
 - DFT, FFT algorithms, spectral analysis.
 - FIR and IIR filter design and implementation.
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Unit 7: Communication Systems

- Modulation techniques: AM, FM, PM, DSB, SSB, VSB.
 - Pulse modulation: PAM, PWM, PPM, PCM, delta modulation.
 - Digital modulation: ASK, FSK, PSK, QPSK, error performance.
 - Noise in communication systems, SNR, noise figure, detection.
 - Spread spectrum, multiplexing (TDM, FDM), bandwidth calculations.
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Unit 8: Control Systems and Embedded Systems

- System modeling using differential equations and transfer functions.
 - Block diagrams, signal flow graphs, time and frequency domain analysis.
 - Stability criteria: Routh-Hurwitz, Nyquist, Bode plots, Root locus.
 - Embedded systems: architecture of 8051, peripherals and interfacing.
 - Microcontrollers, memory and I/O interfacing.
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Unit 9: Electromagnetic Fields and Microwave Engineering

- Vector calculus, Maxwell's equations, boundary conditions.
 - Wave propagation in lossless and lossy media.
 - Transmission lines: impedance matching, Smith chart, VSWR.
 - Waveguides, cavity resonators, Microwave devices: klystron, magnetron, Gunn diode.
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Unit 10: Advanced Topics: Wireless and VLSI

- Wireless communication: fading, path loss, propagation models.
- Cellular concepts: frequency reuse, handoff, capacity analysis.
- VLSI design: CMOS logic, layout, combinational/sequential design.