

## Department of Electronics & Communication Engineering

### Entrance Test Syllabus for admission in Ph.D. ECE

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

**Continuous-time Signals:** Fourier series and Fourier transform, sampling theorem and applications.

**Discrete-time Signals:** DTFT, DFT, z-transform, discrete-time processing of continuous-time signals.

**LTI systems:** definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay.

**Electronic Devices** 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.

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

**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 triggers and oscillators.

**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.

**Control Systems** 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; Lag, lead and laglead compensation; State variable model and solution of state equation of LTI systems.

**Communications Random Processes:** auto correlation 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, mutual information and channel capacity theorem.

**Digital Communications:** PCM, DPCM, digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth, inter-symbol interference, MAP, ML detection, matched filter receiver, SNR and BER.

Fundamentals of error correction, Hamming codes, CRC.

**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.

**Chairperson-EEE**