

School of Engineering and Technology
Department of Electrical Electronics and Communication
PhD in ECE

Syllabus for Ph.D. Entrance Exam

Networks, Signals and Systems:

Circuit analysis, Continuous-time signals, Discrete-time signals

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, photodiode, 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, and 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, 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 lag-lead compensation; State variable model and solution of state equation of LTI systems.

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, superheterodyne 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.

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