

Indian Institute of Technology Roorkee-247667

Syllabus for written examination (Ph D) scheduled on April 19 2017

Networks, Signals, Systems & Control: Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton's, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks. Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques. 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

Electronic Devices and Circuits: Energy bands in intrinsic and extrinsic silicon; 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; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process. Analog Circuits Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and opamp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation. Number systems; 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 and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

Communication Systems: 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, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

RF- to -THz Circuits, Systems & Sensors : Maxwell's equations and boundary conditions, Power and Energy relations, EM wave equation and its solution in rectangular coordinates, Plane wave propagation and polarization, Uniform plane wave in an unbounded lossy and loss less media, Reflection and refraction of plane wave at a media interface, Fresnel equations, Brewster angle, Frequency domain analysis of transmission lines, terminated transmission lines, Reflection Coefficient & SWR, Single & double stub matching, single and multi-section impedance transformers, Wave propagation in rectangular wave guides, hybrid modes, partially filled wave guides, Z, Y, and ABCD parameters, Scattering parameters, Mixed mode scattering parameters, S-parameter analysis of two, three and four port microwave networks, Fundamental concepts in Antennas and array of antennas, Planar antennas for RF integrated circuits & systems applications, Characterization of antennas, Noise and nonlinearity in RF integrated circuits, Substrates for MIC, Planar transmission lines and their characteristics for MIC, Open, Short, Gap, Step, T junction discontinuities in planar transmission lines and their equivalent circuits, Design of branch line and parallel coupled directional couplers, Design of low pass, high pass, band pass and band reject filters by insertion-loss method, RF integrated circuits using nonlinear passive semiconductor devices, RF integrated circuits using nonlinear semiconductor devices.

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11/4/2017