Syllabus

Circuit analysis, Node and mesh analysis, Superpositiontheorem, Thevenin's theorem, Norton's theorem, reciprocity, Sinusoidal steady state analysis,Phasors, Complex power and 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, Multirate filterbank, Adaptive signal processing.

Random processes,Autocorrelation and power spectral density, Properties of white noise, filtering of random signals through LTI systems, Inter-symbol interference, MAP, ML detection, Matched filter receiver, SNR and BER,Analog modulation and demodulation, AM, FM and PM, Principle of super heterodyne receiver, Random signals, Noise, Noise temperature and noise figure, Basic concepts of information theory, Error detection and correction, Digital modulation and demodulation, PCM, ASK, FSK, PSK, BPSK, QPSK and QAM, TDM, FDM, Multiple Access techniques, Data Communications, Modems, Codes, Principles of Mobile and Satellite Communication, Optical Fiber communication andOptical sources, LED, spontaneous and stimulated emission, semiconductor Lasers, Detectors, PIN photodiodes, Avalanche photodiodes (APD), Optical fibers, attenuation and dispersion characteristics, Bandwidth, Wavelength division multiplexing, Fundamentals of Internet of Things (IoT) for communication.

Electrostatics, Vector calculus, Gauss's Law, Laplace and Poisson's equations, Magnetostatics,BiotSavert's law, Ampere's law and electromagnetic induction, Maxwell's equations and wave equations, Plane wave propagation in free space, Dielectrics and conductors, Poynting theorem, Reflection and refraction, Polarization, Interference, Coherence and diffraction, Transmission lines and waveguides, Line equations, Impedance, Reflections and voltage standing wave ratio, Rectangular waveguides, Antennas, Retarded potential and Hertzian dipole, Half wave antenna, Antenna patterns, Radiation intensity, Gain, Effective area and Frii's free space receiver power equation, 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, Light propagation in optical fibers, Dipole and monopole antennas, Linear antenna arrays. Microwave Sources and Devices, Reflex Klystron, Magnetron, TWT, Gunn diode, IMPATT diode, Crystal Detector and PIN diode, Radar, Block diagram of Radar, Frequencies and power used, Radar range equation, EMI-EMC definitions and Units of parameters, Sources and victim of EMI, Conducted and Radiated EMI Emission and Susceptibility, Transient EMI, ESD, Radiation Hazards, Terahertz Overview and Principles, Terahertz Sources & Receivers, Terahertz Optoelectronics.

IC fabrication, Crystal growth, Epitaxy, Oxidation, Lithography, Doping, Etching, Isolation Methods, Metallization, Bonding, Thin film deposition and characterization Techniques, XRD, TEM, SEM, EDX, Thin film active and passive devices, MOS technology and VLSI, Scaling of MOS devices, NMOS and CMOS structures and fabrication, Characteristics of MOS transistors and threshold voltage, NMOS and CMOS inverters, Charge-Coupled Device (CCD) structure,

Charge storage and transfer, Basics of VLSI design, Stick diagrams, Layout design rules, CAD, CAM, Analog CMOS IC Design, Overview of Embedded System.

Rectifiers, Voltage regulated ICs and regulated power supply, Biasing of Bipolar junction transistors and FETs, operating point and stability, Amplifiers, Classification of amplifiers, Concept of feedback, Hartley, Colpitt's and Phase Shift oscillators, Operational amplifiers (OPAMP), Characteristics of OPAMP, Computational applications, Comparators, Schmitt trigger, Instrumentation amplifiers, Wave shaping circuits, Phase locked loops, Active filters, Multivibrators, Voltage to frequency convertors (V/F), Frequency to voltage convertors (F/V).

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, 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.

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.

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.

Sample Questions

(1) When a reverse bias is applied to a junction diode

(a) Potential barrier is lowered
(b) Majority carrier current is increased
(c) Minority carrier current is increased
(d) potential barrier is raised

(2) The cut-off wavelength (in μm) of light that can be used for intrinsic excitation of a semiconductor material of bandgapEg= 1.1 eV is__?

(a) 0.85
(b) 1.125
(c) 1.450
(d) 2.250

(3) A BJT in a common-base configuration is used to amplify a signal received by a 50 ohm antenna. Assume kT/q = 25 mV. The value of the collector bias current (in mA) required to match the input impedance of the amplifier to the impedance of the antenna is__?

(a) 0.2
(b) 0.4
(c) 0.5
(d) 0.75

(4) If calls arrive at a telephone exchange such that the time of arrival of any call is independent of the time of arrival of earlier or future calls, the probability distribution function of the total number of calls in a fixed time interval will be____?

(a) Poisson
(b) Gaussian
(c) Exponential
(d) Gamma

(5) For an antenna radiating in free space, the electric field at a distance of 1 km is found to be 12mV/m. Given that intrinsic impedance of the free space is $120\pi\Omega$, the magnitude of average power density due to this antenna at a distance of 2 km from the antenna (in nW/m2) is_____?

(a) 50.7
(b) 48.7
(c) 45.7
(d) 47.7