Entrance Test Syllabus for M.Tech (Embedded Systems and Solutions)
Academic Session-2018

Unit 1: Linear Algebra and Calculus

Linear Algebra: Vector space, basis, linear dependence and independence, matrix algebra, eigen values and eigen vectors, rank, solution of linear equations – existence and uniqueness.

Calculus: Mean value theorems, theorems of integral calculus, evaluation of definite and improper integrals, partial derivatives, maxima and minima, multiple integrals, line, surface and volume integrals, Taylor series.

Unit 2: Differential Equations and Vector Analysis

Differential Equations: First order equations (linear and nonlinear), higher order linear differential equations, Cauchy's and Euler's equations, methods of solution using variation of parameters, complementary function and particular integral, partial differential equations, variable separable method, initial and boundary value problems.

Vector Analysis: Vectors in plane and space, vector operations, gradient, divergence and curl, Gauss's, Green's and Stoke's theorems.

Unit 3: Complex Analysis, Numerical Methods and Probability

Complex Analysis: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula; Taylor's and Laurent's series, residue theorem.

Numerical Methods: Solution of nonlinear equations, single and multi-step methods for differential equations, convergence criteria.

Probability and Statistics: Mean, median, mode and standard deviation; combinatorial probability, probability distribution functions - binomial, Poisson, exponential and normal; Joint and conditional probability; Correlation and regression analysis.

Unit 4: Network Analysis

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.

Unit 5: Signals and Systems

Introduction to 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.

Unit 6: Semiconductor Materials and Devices

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.

Unit 7: Analog Electronics

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 op-amp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

Unit 8: Digital Electronics

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;

Unit 9: Microprocessor and Microcontroller

Introduction to 8-bit microprocessor (8085): 8085 Microprocessor Architecture, Address, Data and Control Buses. 8085 Pin functions, 8085 Instruction Set, Instructions and Data Formats, 8085 Interrupts, Programming, Stacks and Subroutines. I/O devices, Memory and I/O operations. Programmable Interrupt Controller 8259A, Programmable Peripheral Interface 8255A. Interfacing Concepts, Interfacing 8155, 8255, 8279, 8253, 8257, 8259,8251 with 8085 Microprocessor. Introduction to 8051 Microcontrollers Architecture, Features, Pin layout, addressing modes, accessing memory using various addressing modes.

Unit 10: Control System

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.

Unit 11: Analog Communication System

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.

Unit 12: Digital Communication System

Digital communications: PCM, DPCM, digital modulation schemes (ASK, PSK, FSK).Fundamentals of error correction, Hamming codes; Electrostatics; Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters. Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays.

Unit 13: Computer Networks

Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls. Basics of TDMA, FDMA and CDMA.

Unit 14: Computer Organization and Architecture

Memory hierarchy, types and characteristics, Primary Memory-Types, Working, Cache Memory- Mapping Schemes, Replacement Policies; I/O interface (interrupt and DMA mode). Machine instructions and addressing modes. ALU, data-path and control unit. Introduction to Parallel Processing,Instruction pipelining. Scalar Data types: Sign Magnitude, One's and Two's Complement Representation of Integers. Integer Arithmetic, Floating Point Arithmetic. Booth's Algorithm and Hardware Implementation.

Unit 15: Introduction to Programming

Introduction of High-level Proramming Language, Introduction of data in C. Operators and its precedence, Various data types in C, Storage classes in C, Decision-making and forming loop in program, Handling character, Arrays in C, Structure and Union, User defined function, Pointers in C, Advanced pointer. Pointer to structures, pointer to functions, Dynamic data structure, file handling in C, Command line argument, Graphics-video modes, video adapters, Drawing various objects on screen, Interfacing to external hardware via serial/parallel port using C, Applying C to electronic circuit Problems.

Note: Four multiple choice questions will be set from each of the above units. Each question shall carry one mark.