B.Tech. in ELECTRONICS & COMMUNICATION ENGINEERING / ELECTRONICS & TELECOMMUNICATION ENGINEERING

Syllabus of Paper – 1

SIGNALS AND SYSTEMS

Signals and Systems: What is a signal and a system, classification of signals, properties ofsystems, Noise, Continuous-Time and Discrete-Time Systems, Basic System Properties, Basic System Properties Linear Time Invariant Systems: The convolution sum and integral, Relations between LTI system properties and the Impulse Response, Step Response, Block diagram representations, State variable descriptions of LTI systems.Fourier representationsof signals: Fourier Series Representation of Periodic Signals, Continuous-Time FourierTransform, Discrete-Time Fourier Transform, Properties of Fourier Representations, Finding inverse Fourier Transforms by using Partial fraction expansions, Parseval Relationships, Time-Bandwidth Product. Applications of Fourier representations to mixed signal classes: Fourier Transform representations of Periodic signals and discrete time signals, Sampling, Fourier series representations of Finite duration non periodic signals. Representing Signalsby using Continuous-Time complex Exponentials: The Laplace Transform: The LaplaceTransform, Unilateral Laplace Transform, Properties of Unilateral Laplace Transform and bilateral Laplace Transform, properties of the region of convergence, Causality and Stability, Determining the Frequency Response from Poles and Zeros. Representing signals by usingdiscrete-time complex exponentials: The Z-Transform: The Z-Transform, Properties ofRegion of Convergence, Properties of the Z-Transform, Inversion of the Z-Transform, Causality and Stability, The Unilateral Z-Transform. Application to Linear Feedback Systems: Basic feedback concepts, Sensitivity and Distortion analysis, the stability problem, Routh-Hurwitz criterion, Root locus method, Nyquist Stability Criterion, Bode diagram.

ANALOG ELECTRONICS

Bipolar Junction Transistor: Small Signal model, BJT biasing for discrete circuit design, single stage amplifier analysis, complete static characteristic, internal capacitances and second order effect.; Field-Effect Transistor: MOSFET as amplifier, biasing of MOS amplifier circuits, single stage IC-MOS amplifiers, MOSFET as analog switch, Small signal model of MOSFET for high and low frequencies.; Spice model and analysis of FET circuits.; Frequency Response Analysis: S-domain analysis, Bode plot, amplifier transfer function, low frequency and high frequency response of common-source and common drain amplifiers, Current Mirrors, Cascode Amplifier.; Feedback Amplifier: General feed-back structures, negative feedback, the 4 basis feedback topologies and their analysis, close loop gain calculation, Oscillators.; Output stage and Power Amplifier: Classification of output stages, Class A, Class B, Class AB amplifiers; Differential and Multistage Amplifier: BJT differential amplifier, Small signal operation of BJT differential amplifier, non-ideal characteristics of differential amplifier, multistage amplifiers. Phase Locked Loops: Simple PLL Operation, Applications.

NETWORK ANALYSIS AND SYNTHESIS

Elementary circuit analysis: DC and AC analysis of RL, RC and RLC series circuits.Resonance: Series and Parallel resonance. Loop and node variable analysis. Analysis of coupled circuits. Source transformation. Loop and node variable analysis. Network theorems. Network topology and graph concepts: Introduction to graph of networks. Incidence

matrix.Loop/circuit matrix. Cutset matrix. Relation between branch voltage matrix, twig voltage matrix and node voltage matrix. Relation between branch current matrix and loop current matrix. Network Equilibrium equations. Duality in networks. Transient response and initialconditions: Representation of networks by first and second order differential equations.General and particular solution. Time constants and integrating factors. Initial conditions and procedure to evaluate them. Second order equations with internal and external excitation. Response as related to s-plane location of roots. Network functions: Poles and zeros:Network functions for one port and two port. Network function for ladder and general networks. Poles and zeros of network functions. Restriction of poles and zeros location for driving point functions. Restriction of poles and zeros location for transfer function. Time domain behaviour and stability from pole zero plot. Two port parameters: Short circuit admittance parameters. Open circuit impedance parameters. Transmission and hybrid parameters. Relationship between parameter sets. Parallel and cascade connection of Two port networks. Passivefilters and attenuators: Classification and characteristics of filters, Constant K low and highpass filters. Bandpass and bandstop filters. M-derived filters. Terminating half sections. Composite filters and attenuators. Network synthesis: Hurwitz polynomials. Positive real functions. Elementary synthesis concepts. Realization of LC, RC and RL functions.

ELECTROMAGNETIC THEORY

Laplace and Poisson's equation, Solution of Laplace equation by separation of variables in Cartesian, cylindrical and spherical co-ordinates, cylindrical and spherical harmonics, Examples.; Maxwell's equations for static fields, their modifications for time-varying fields conducting and dielectric media.; EM Wave equations and uniform plane waves, in free space and in lossy medium, wave propagation in good dielectrics, in good conductors: Depth of penetration, Poynting vector and power flow, Reflection and refraction of EM Waves.; Transmission lines: Transmission line equations, Parameters- primary and secondary constants, Reflection coefficient and SWR, Matched Transmission line, Impedance matching, Smith chart problems, Analogy of transmission lines with e. m. waves.; Guided waves and Waveguides: Electric and magnetic fields in rectangular waveguide; TE, TM and TEM modes, Dominant modes, λc, λg, Vp, Vg, Numerical examples.; Radio Wave Propagation: Modes of propagation, Structure of Troposphere, Tropospheric Scattering, Ionosphere, Ionospheric Layers - D, E, F1, F2, regions. Sky wave propagation - propagation of radio waves throughIonosphere, Effect of earth's magnetic field, Virtual height, Skip Distance, MUF, Critical frequency, Space wave propagation.

DIGITAL ELECTRONICS

Design Concepts**:** Digital Hardware, Design Process, Hardware, Logic Circuit Design, Theoryand Practice; Introduction to Logic Circuits**:** Variables and Functions, Inversion, Truth Tables, Logic Gates and Networks, Boolean Algebra, Synthesis using AND, OR AND NOT Gates, Design Examples, Introduction to Cad Tools, Introduction to VHDL.; Implementation Technology**:** Transistor Switches, NMOS Logic Gates, CMOS Logic Gates, Negative Logic System, Standard Chips, Programmable Logic Devices, Custom Chips, Standard Cells and Gate Arrays Practical Aspects, Transmission Gates, Implementation details for FPGAs.; Optimized Implementation of Logic Functions**:** Karnaugh Map, Strategy for Minimization, Minimization of Product-of-Sums Forms, Incompletely Specified Functions, Multiple Output Circuits, NAND and NOR Logic Networks, Multi-Level Synthesis, Analysis of Multi-Level Circuits, CAD Tools.; Number Representation And Arithmetic Circuits: Positional Number Representation, Addition of Unsigned Numbers, Signed Numbers, Fast Adders, Design of Arithmetic Circuits Using Cad Tools.; Combinational Circuit Building Blocks: Multiplexers, Decoders, Encoders, Code

Converters, Arithmetic Comparison Circuits, VHDL for Combinational Circuits.; Flip-Flops, Registers And Counters, A Simple Processor: Basic Latch, Gated SR Latch, Gated D Latch. Master-Slave and Edge-Triggered D Flip-Flops, T Flip-Flop, JK Flip-Flop, Registers, Counters, Reset Synchronization, Other Types of Counters, Using Storage Elements with Cad Tools, Using Registers and Counters With Cad Tools, Design Examples.; Synchronous Sequential Circuits**:** Basic Design Steps, State Assignment Problem, Meanly State Model, Design of Finite State Machines using CAD Tools, Serial Adder Example, State Minimization, Design of a Counter using the Sequential Circuit Approach, FSM as an Arbiter Circuit, Analysis of Synchronous Sequential Circuits.

PRINCIPLES OF COMMUNICATION SYSTEMS

SPECTRAL ANALYSIS: Fourier series, Response of a linear system, Normalized power in aFourier expansion, Power spectral density. The Fourier transform, Convolution, Parseval's theorem, Power and energy transfer through a network, Auto and Cross correlations. AMPLITUDE MODULATION SYSTEMS: Frequency translation, Recovery of base band signal,Amplitude Modulation, Maximum Allowable Modulation. The square Law demodulator, Spectrum of AM signal, Balanced Modulator, SSB modulation and generation, VSB, FDM. FREQUENCY MODULATION SYSTEM: Phase and frequency modulation and theirrelationship, Frequency deviation, spectrum of FM Signal, BW of FM signal, Effect of modulation on BW, constant BW, FM phasor diagram, Narrow band FM, Armstrong and Parameter Variation methods of FM generation. FM Department of Electronics & Communication Engineering Demodulators. ANALOG TO DIGITAL CONVERSION: Pulse Modulation Systems, Sampling theorem, Pulse Amplitude Modulation, Quantization of signals, Quantization error, Pulse code modulation (PCM) system, Companding, Time division multiplexing (TDM), DPCM, DM, ADM. Basic Digital Modulation Techniques: DM, ADM, DPCM and ADPCM for speech, ASK, PSK, QAM, FSK etc. Baseband Communication: Line coding, Matched filter, correlation receiver, basics of inter symbol interference, Equalization. NOISE IN COMMUNICATION SYSTEM: Resistor noise, Available power, Noise temperature,Noise bandwidth, Two ports Noise bandwidth, Input Noise temperature, Noise figure, Equivalent-Noise temperature of a cascade; example of receiving system.

Syllabus of Paper - 2

SEMICONDUCTOR DEVICES

Energy Bands and charge carriers in semiconductors: Energy bands, direct and indirect semiconductors, Electrons and holes, Intrinsic and extrinsic materials, Fermi-Dirac distribution function, electron and holes concentrations at equilibrium, space charge neutrality, conductivity and mobility, Hall effect. Excess carriers in semiconductors: Drift, Diffusion: Current equation, Einstein's Relationship,Continuity equation; Generation & Recombination: Mechanisms, Minority Carrier Lifetime; P-Njunction: Principles, DC model, Capacitance of Reverse bias PN junction, store charge effects, Metal Semiconductor contacts: Schottky diode, Ohmic Contact MOS Capacitor;MOSFET:Principles, C-V Characteristics, Second order effects; BJT: principles, C-V Characteristics,Second order effects; IC Technology: Bipolar IC Technologies; MOSFET Technologies; BICMOS Technologies Microwave FETs & Diodes; IGBT, Thyristors.

CONTROL SYSTEM ENGINEERING

Introduction: Modeling in Frequency domain, Mechanical system, Electromechanical system, Electric circuitanalogs. Modeling in Frequency domain:State space representation,converting from state space to T.F., Time Response: poles, zeros and system responses.

Reduction of Multiple subsystems: Block diagrams, Signal flow graphs, Mason's Rule, Signalflow graph of state equation. Stability: Routh- Hurwitz Stability criteria. Steady state Error analysis Root locous Techniques Design Via Root locous Frequency response Technique: Bode plot, Nyquist Diagram, PM, GM, stability. Design Via Frequency response: Lag compensator, Lead compensator, Lag-Lead compensator.

DIGITAL SIGNAL PROCESSING

Introduction: Signals, systems and signal processing, concept of frequency in continuous anddiscrete time signal; Discrete-time Signals and Systems: Discrete time signals and systems, analysis of LTI system and implementation, correlation; Z-Transform: Generalized complex exponentials as eigensignals of LTI systems, z-transform definition, region of convergence (RoC), properties of RoC, properties of the z-transform, inverse z-transform methods-pole-zero plots, time-domain responses of simple pole-zero plots, RoC implications of causality and stability; Frequency Domain Analysis: Frequency analysis of continuous-time and discrete-time signals and LTI systems, LTI system as frequency selective filter, inverse system and de-convolution. ; Discrete Fourier Transform (DFT): Definition of the DFT and inverse DFT, DFT as the samples of the DTFT and the implied periodicity of the time-domain signal, recovering the DTFT from the DFT, circular shift of signal and the "index mod N" concept, properties of the DFT, circular convolution and its relationship with linear convolution, sectioned convolution methods: overlap add and overlap save, effect of zero padding, introduction to the Fast Fourier Transform (FFT) algorithm, decimation-in-time and decimation-in-frequency algorithms.; Implementation of Discrete-Time System: FIR system, IIR system, Design of Digital Filters: Design of FIR and IIR filters, Recent Developments.

DIGITAL COMMUNICATION

Analog to digital conversion: Pulse Modulation Systems, Sampling theorem, PulseAmplitude Modulation, Quantization of signals, Quantization error, Pulse code modulation (PCM) system, Companding, Time division multiplexing (TDM), DPCM, DM, ADM. Digital modulation techniques: BPSK, DPSK, DEPSK, QPSK, M-ary PSK, BFSK, M-ary FSK, M-QAM, MSK,

GMSK. Optimum receivers for AWGN channel: Optimum receiver for signals corrupted byAWGN, performance of optimum receiver for memory less modulation, optimum receiver for CPM signals, optimum receiver for signals with random phase in AWGN channel. Carrier and symbol synchronization: Signal Parameter estimation, carrier phaseestimation, symbol timing estimation, Joint estimation. Channel capacity and coding: Channel models and channel capacity, Block codes–coding and decoding, cyclic codes, algebraic codes, Reed-Solomon Code, Convolutional codes.Spread spectrum signals for digital communication: Direct sequence (DS)spread spectrum and its applications, frequency hopping (FH) spread spectrum, synchronization of spread spectrum systems.

VLSI DESIGN TECHNIQUES

Introduction to VLSI Design, Levels of abstraction and the complexity of design, Challenges of VLSI design: power, timing, area, noise, testability, reliability and yield ; CAD tools: simulation, layout, synthesis, test; MOS modeling, MOS device models, Short-channel effects and velocity saturation, Scaling of MOS circuits; VLSI fabrication technology, Layout design, Design rules, Stick diagrams; The CMOS inverter, VTC, Switching behavior, Noise margins and power dissipation; Static and dynamic CMOS combinational logic gate, Transistor sizing in static CMOS, logical effort , Pass-transistor logic, sizing issues , Domino logic gates , estimating load capacitance , Simple delay models (RC) for CMOS gates , Power consumption; Latches and clocking, Flip-flops, Set-up and hold tests, Static and dynamic latch and flip-flop, Clock design; Datapath units, Adders, Shifters, Multipliers; Control logic strategies, PLAs , Multi-level logic, Synthesis and place-and-route CAD; MOS memories , Register, SRAM , DRAM; Global interconnect modeling, Capacitance, resistance and inductance of interconnect; Signal and power-supply integrity issues, Electromigration, RC interconnect modeling Driving large capacitive load, reducing RC delays; Layout design, Standard-cell layout, Chip layout and floor planning, Array layout; Implementation issues, Design for testability, Packaging technology, I/O issues: ESD protection, boundary scan, inductance, synchronization.

MICROWAVE ENGINEERING

Introduction: Microwave frequencies, Standard Frequency bands, Behaviour of circuits at Conventional and microwave frequencies, Microwave application, Review of Maxwell's equations; Waveguide: Overview of guided waves; TE, TM and TEM modes, circular wave guide, Choice of the type of waveguide dimensions, waveguide problems.; Microwave Components & Devices : Scattering matrix and its Properties, coupling probes, coupling loops, windows, Waveguide tuners, Termination, E-plane Tee, H-plane Tee, Magic Tee, Phase-Shifter, attenuators, Directional coupler, Gunn diode, Microwave transistor MASER, Resonator and circulators.; Microwave Generators: Transit-time effect, Limitations of conventional tubes, Two-cavity and multi-cavity Klystrons, Reflex Klystron, TWT and Magnetrons.; Microwave Measurements : Power measurement; Calorimeter method, Bolometer bridge method, thermocouples, Impedance measurement, Measurement of frequency and wavelength, Measurement of unknown loads, Measurement of reflection coefficient, VSWR and Noise, Microwave test bench.

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