B. Tech. in ELECTRONICS & INSTRUMENTATION 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.

ELECTRICAL AND ELECTRONICS MEASUREMENT

Fundamentals of measurement: Systems and Standards; Galvanometers: Construction, Performance, Steady state and Dynamic Behaviors of d'Arsonval, Vibration, and Ballistic Galvanometers.; Electromechanical Indicating Instruments: Ammeters and Voltmeters: PMMC, Moving-Iron, and Electro dynamic type; Ohmmeters: Series type and Shunt-type Ohmmeters; Thermo-instruments, Watt-hour Meters, Power-Factor Meters and Instrument Transformers; Potentiometers: DC and AC; BRIDGES: D. C. Bridges: Wheatstone bridge, and Kelvin bridge., A.C. Bridges and their Applications: Maxwell bridge, Hay bridge, Schering bridge, and Wein bridge, Measurement of high resistance by Megger; Electronic Instruments For Measuring Basic Parameters: Amplified DC Meter, AC Voltmeter Using Rectifiers, True RMS– Responding Voltmeter, Electronic Multimeter, Digital Voltmeters: Ramp type, Integrating type, and Successive-Approximation type; Component Measuring Instruments: Q-meter, Vector Impedance Meter, Vector Voltmeter, RF Power and Voltage Measurements.

DIGITAL ELECTRONICS

Design Concepts**:** Digital Hardware, Design Process, Hardware, Logic Circuit Design, Theory and 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.

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-N junction: 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.

INSTRUMENTATION DEVICES

Basic concept of Instrumentation System, Purpose, structure and elements. StaticCharacteristics Of Measurement System Elements: Systematic characteristics,Generalised Model of System element, statistical characteristics. The Accuracy OfMeasurement System In The Steady State: Measurement error of a system of idealelements. The error probability density function of a system of non-ideal elements. Error reduction techniques. Dynamic Characteristics Of Measurement Systems: Transfer function for typical system elements, step and frequency response. Dynamic errors in measurement systems. Techniques for dynamic compensation. Loading Effects InMeasurement System: Electrical loading, Generalised loading.Signal And Noise In Measurement System: Statistical representation of random signals: Effects of Noise andinterference on Measurement circuits, Noise sources and coupling mechanism, Method of reducing effects of Noise and interference. Sensing Elements: Resistive (Potentiometers, Resistance Thermometer, Strain Gauges), Inductive (Variable reluctance, LVDT), Capacitive (variable area, gap, dielectric), Magnetic type (eddy current, magnetostrictive, magnetoresistive), Thermoelastic, Elastic, Piezoelectric, Photoelectric, Hall effect, Synchros. Signal Conditioning Circuits: Potentiometer Circuit (constant voltage and constantcurrent), Wheatstone Bridge (constant voltage and constant current), Instrumentation Amplifier.

Syllabus of Paper - 2

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, Signal flow 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 and discrete 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 eigen signals 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.

PROCESS CONTROL

Introduction To Process Control: A Process Control System, Important terms and the objectives of Automatic Process Control, Transmission Signals, Control Strategies; Mathematical Tools: Deviation variables, Linearization of functions of one variable, Linearization of functions of two or more variables; First-Order Dynamic System: Thermal Process, Dead time, Level process, Response of first-order processes; Higher-Order Dynamic Systems: Tanks in series – Noninteracting systems, Interacting systems, Thermal process, Response of higher order systems; Basic Components Of Control System: Sensors and Transmitter, Control Valves, Feedback controllers (P, PI, PID); Design of Single-Loop Feedback Control Systems: Feedback control loop, Stability of the control loop, Tuning of feedback controllers, Synthesis of feedback controllers.

INDUSTRIAL INSTRUMENTATION

Introduction to industrial instrumentation, Pressure measurement: Manometer, Elastic transducers: Bourdon tube, Bellows, Diaphragm, Low pressure measurement: McLeaod gauge, Thermal conductivity gauge, Ionization gauge, High pressure measurement. Temperature measurement: Thermal expansion methods, Thermoelectric sensors, Electrical resistance sensors,

Radiation methods, Optical Pyrometer, Blackbody-tipped fiber optic radiation thermometer, Temperature measuring problems in flowing fluids. Flow measurement: Laminar and turbulent flow, Differential pressure flow meters, Variable area flow meter, Vortex shedding flow meter, Positive displacement flowmeter, Noninvasive methods, Level measurement: Float systems, Pressure measuring devices, Ultrasonic level gauge, Capacitive devices, Fiber optic sensors. Recent developments.

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 behaviour, Noise margins and powerdissipation; 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.

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