UES007 SEMICONDUCTOR DEVICES

Prerequisite(s): None


Semiconductor Devices: p- n junction diode: Ideal diode, V-I characteristics of diode, Diode small signal model, Diode switching characteristics, Zener diode, Tunnel diode, Schottky Barrier diode, Diode Photo, LED, JFET, MOSFET, MESFET, Their construction, Operation and Characteristics.

Bipolar Junction Transistor: Operation of transistor and its current components, Transistor circuit configuration: CB, CE, CC (Relationship between α, β, γ), Input-output characteristics, Concept of Q point and load line, DC and AC analysis, Ebers-Moll Model, Biasing circuits and stability criterion, Switching characteristics of transistor, The h-parameter model of CE, CB and CC configurations, Inter-conversion of hybrid parameters, Analysis of BJT Amplifier using h-parameters.

High frequency analysis of transistor: High frequency hybrid T-model for CB and π model for CE transistor, High frequency capacitances, fα, fβ and fγ-parameters in terms of current gain, Transistor amplifier parameters using rπ model.

Field Effect Transistors: Biasing of JFET and MOSFET, Load line, Equivalent circuits of the device and analysis of FET amplifiers, High frequency model of MOSFET amplifier, MESFET and its characteristics.

Power Supplies: Half-wave and Full wave p-n diode rectifier, Bridge rectifier, Filter circuits, Zener diode as a Voltage Regulator, Series Voltage Regulators and I.C., Voltage Regulators.

Laboratory Work
Familiarity with CRO and Electronic Components.

1. Diodes characteristics (P-N Junction and Zener diode).
2. Characteristics of Schottkey barrier diode and comparison with ordinary p-n diode.
3. Input-Output characteristics BJT in Common Emitter Configuration.
5. MOSFET characteristics, and evaluation of μ, gm and rd. verify μ = gm * rd.
6. Zener diode as voltage regulator.
7. Transistorized Series voltage regulator.
8. Half-wave and Full wave Rectifiers with filter and without filter and Estimation of ripple factor.

Text Books
Reference Books

Prerequisite(s): None

Multistage or Cascaded Amplifiers: Classification of Multi-stage Amplifier, Coupling and frequency response of cascaded systems with and without Bode plot, Types of coupling, Effect of cascading on voltage gain, Current gain, Phase, Input and output impedances and bandwidth Analog of cascaded or multistage amplifiers, Cascade and Cascade circuits, Miller Theorem, Darlington pair, Bootstrap Circuits.

Tuned Amplifiers: Single tuned, double tuned and stagger tuned amplifiers and their frequency response characteristics.

Power Amplifiers: Class A, B, AB, Push pull & Class C amplifiers, Comparison of their Efficiencies, Types of distortion, working of SCR, UJT.

Feedback Amplifiers: Concept of feedback, Positive and negative feedback, Voltage and current feedback, Series and shunt feedback, Effect of feedback on performance characteristics of an amplifier.

Oscillators: Condition for sustained oscillation, Barkhausen criterion, R-C phase shift, Hartley, Colpitts, Crystal and Wien Bridge Oscillators, Frequency stability criterion.

Wave shaping circuits: Multi-vibrators (Astable, Mono-stable, Bi-stable), High pass and low pass filters using R-C Circuits and R-L, R-L-C Circuits & their response to step input, Pulse input, Square input and Ramp Input, Attenuators, Clamping Circuit theorem, Clipping and Clamping circuits, Schmitt Trigger, Comparator.


Laboratory Work
1. Frequency response analysis of RC coupled amplifier.
2. Frequency response analysis of Tuned amplifiers.
4. SCR Characteristics.
5. Frequency response analysis of Feedback amplifier.
7. RC Phase shift oscillator.
10. Schmitt Trigger.

Text Books
Reference Books

Number Systems: Number systems, Conversions, Number Representations, Demorgan’s Theorem, Boolean algebra and Arithmetic operations, Binary codes, Error detection and correction codes.


Sequential circuits: Various types of flip-flops and their conversions, Registers, Counters – Ring, Johnson, Asynchronous & Synchronous, Timing issues, Setup and hold times, Standard ICs for their applications, Finite State Machines – Moore and Mealy, Design of Synchronous and Asynchronous sequential circuits, Races and hazards.

Memories: Types of ROM, RAM- Static and Dynamic, Representative circuits for cells using BJTs and FETs, Memory expansion using ICs, Flash memory, CCD, Latest trends in memories.

Converters: Analog-to-Digital and Digital-to-Analog Converters, Their types and comparison.

Logic Circuits: DTL, TTL, MOS, CMOS logic families their comparison, Detailed study of TTL, CMOS and their characteristics, Fan-in, Fan-out, Unit load, Propagation delay, Power dissipation, Current & voltage parameters, Tristate Logic, Interfacing of TTL & CMOS logic families.

Laboratory Work
To study basic gates and design combinational circuits using them, To study latches and Flipflops, Design of registers and asynchronous/synchronous up/down counters, Variable modulus counters, Usage of IC tester, Computer simulation using EDA tools.

Text Books

Reference Books
Prerequisite(s): None

**Analog Modulation Techniques:** Theory of amplitude modulation, AM power calculations, AM modulation with a complex wave, Concepts of angle modulation, Theory of frequency modulation, Mathematical analysis of FM, Spectra of FM signals, Narrow band FM, Wide band FM, Phase modulation, Phase modulation obtained from frequency modulation, Comparison of AM, FM & PM.

**AM Transmission:** Generation of Amplitude Modulation, Low level and high level modulation, Basic principle of AM generation, Square law modulation, Amplitude modulation in amplifier circuits, Vander bill modulation, Suppressed carrier AM generation (Balanced Modulator) ring Modulator, Product Modulator/balanced Modulator.

**AM Reception:** Tuned Ratio Frequency (TRF) Receiver, Super heterodyne Receiver, RF Amplifier, Image Frequency Rejection, Cascade RF Amplifier, Frequency Conversion and Mixers, Tracking & and Alignment, IF Amplifier, AM detector, AM detector with AGC, Distortion in diode detectors, Double hetero-dyne receiver, AM receiver using a phase locked loop (PLL), AM receiver characteristics.


**FM Reception:** Direct methods of Frequency demodulation, Travis detector/frequency discrimination (Balanced stop detector), Foster seeley of phase discriminator, Ratio detector, Indirect method of FM demodulation, FM detector using PLL, Zero crossing detector as a Frequency Demodulator, Preemphasis / deemphasis, Limiters, The FM receiver, RF Amplifier, FM stereo receiver, Square, Triangular, Sinusoidal FM generation Voltage controlled oscillator.


**SSB Reception:** SSB Product Demodulator, Balanced Modulator as SSB Demodulator, Pilot Carrier SSB Receiver, SSB Double Super-heterodyne Receiver, Compatible SSB (CSSB) Receiver, ISB/Suppressed Carrier Receiver, Modern Communication Receiver.

**Analog Pulse Modulation:** Introduction, Pulse amplitude modulation (PAM), Natural PAM Frequency Spectra for PAM, PAM Time Multiplexing Flat-top PAM, PAM Modulator Circuit, Demodulation of PAM Signals, Pulse Time Modulation (PTM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), PPM Demodulator, Spectra of pulse modulated signals, SNR calculations for pulse modulation systems.

**Noise:** Noise, Resistor noise, Multiple resistor noise sources, Network with reactive elements, Noise Temperature, Noise bandwidth, Effective input noise temperature, Spot and integrated Noise figure and equivalent noise temperature of a Cascade, Bandpass noise representation, Noise calculation in Communication Systems, Noise in Amplitude Modulated System, Noise in angle modulated systems, SNR calculation for AM and FM.
Laboratory Work
Experiments based upon hardware using communication kits and simulation with the help of simulation packages.

Text Books

Reference Books
UEC402 COMPUTER ARCHITECTURE

Prerequisite(s): None


Instruction Set Principles: Classification of Instruction set architectures, Memory Addressing, Operations in the instruction set, Type and Size of operands, Encoding an Instruction set, Program Execution, Role of registers, Evaluation stacks and data buffers, The role of compilers, The DLX Architecture, Addressing modes of DLX architecture, Instruction format, DLX operations, Effectiveness of DLX.

Pipelining and Parallelism: Idea of pipelining, The basic pipeline for DLX, Pipeline Hazards, Data hazards, Control Hazards, Design issues of Pipeline Implementation, Multicycle operations, The MIPS pipeline, Instruction level parallelism, Pipeline Scheduling and Loop Unrolling, Data, Branch Prediction, Name and Control Dependences, Overcoming data hazards with dynamic scheduling, Superscalar DLX Architecture, The VLIW Approach.


Multiprocessors: Characteristics of Multiprocessor Architectures, Centralized Shared Memory Architectures, Distributed Shared Memory Architectures, Synchronization, Models of Memory Consistency.


Text Books

Reference Books
Prerequisite(s): None

Introduction: Circuit components, Network graph, KCL, KVL, Circuit analysis and methods, Mutual inductance, Co-efficient of coupling (Dot analysis), Network Classification.

Network Theorems and Two Port Network Descriptions: Thevenins theorem, Nortons theorem, Maximum power transfer theorem, Superposition theorem, Tellengens theorem, Reciprocity theorem, Two port description in terms of open circuits impedance Parameters, Short circuit admittance parameters, Hybrid parameters, Image parameters, Inter-connection of two port network, Indefinites admittance matrix and its applications, Duality networks.

Network Functions: Concept of Complex frequency, Transform impedances, Network functions of one port & two port networks.

Time domain analysis: Unit, Step, Impulse and ramp function, Solution of networks using Laplace Transform, Steady state analysis of networks.


Filters: Determination of pass and attenuation bands constant K-type, Low pass, High pass, Band pass, Band stop, M-derived filters, Lattice filter, Crystal filters.

Network Synthesis: Concept of Poles & Zero, Reliability of one port Networks, Positive real function (prf) Graphical Interpretation of positive realness, Properties of prf, Even & Odd parts of palimonies Necessary & Sufficient Condition for a function to be positive real function, Hurwitz polynomials, Hurwitz polynomials test, Foster & Caner form properties of driving point impedance function of one port passive lumped reactive element network, Properties of the driving point impedance function of one port passive lumped reactive element network, Properties of the driving point impedance function of RL Network Properties of the driving point Impedance function of RC Network, Minimum Function Realization of Driving point Function of two-element kind by Canonic Networks, Realization of LC driving point function, Synthesis of LC, RC and RL driving point immitance function using Foster and caner first and second forms.

Text Books

Reference Books
Representation of Signals and Systems: Signals, Basic continuous time signals, Energy and power signals, System modeling concepts, Linear time invariant systems, Representation of signals in terms of impulses, Discrete time LTI systems continuous time LTI systems, Properties of LTI systems, Systems described by differential and difference equations, Sampling theorem of sinusoidal and random signals, Quantization.

Fourier Analysis: Continuous and discrete time Fourier series, Trigonometric & exponential Fourier series, Properties of Fourier series, Parseval’s theorem, Line spectrum, Rate of conversion of Fourier spectra, Continuous and discrete time Fourier transforms and its properties, Analysis of discrete time signals and systems, Correlation, Autocorrelation, Relation to Laplace transform.

The Z-Transform: Definition of Z-transform and Z-transform theorems, Relation between Z.T. and F.T., Transfer function, Inverse Z-transform, Discrete time convolution, Stability, Time domain and frequency domain analysis, Solution of difference equation.

Fast Fourier Transforms: Discrete Fourier transform, Properties of DFT, Fast Fourier transforms, Divide and Conquer Approach, Decimation in time and decimation infrequency, Radix-4 FFT, Linear Convolution, Circular Convolution, Power spectrum and correlation with FFT.


Laboratory work
Signal generation, Solving difference equation, Calculating Z-transform, Linear and Circular convolution, Correlation, DFT/IDFT, FFT algorithms using Matlab.

Text Books

Reference Books
Prerequisite(s): None

Pulse Modulation Systems: Model of digital communication systems, Noisy communications channels, Channel capacity of a discrete memory less channel – Hartley Shanon Law, Bandwidth – S/N tradeoff, Shannon’s limit, Sampling theorem for baseband and bandpass signals: natural sampling, Flat top sampling, Signal recovery & holding, Quantization of signal, Quantization error, Source coding & companding, Pulse code modulation (PCM), Noise in PCM systems, Differential pulse code modulation (DPCM), Adaptive pulse code modulation (ADPCM), Delta modulation (DM), Comparison of PCM, DPCM and DM, Adaptive delta modulation, Quantization noise, Time division multiplexed systems (T & E type systems), Calculation of O/P signal power, The effect of thermal noise, O/P signal to noise ratio in PCM, Quantization noise in delta modulation, The O/P signal to quantization noise ratio in delta modulation, Intersymbol Interference, Nyquist criterion for distortionless baseband binary transmission.

Digital Formats and Baseband Modulation: Unipolar and bipolar, Duo binary signaling, Modified duo binary signaling, Correlative coding, NRZ, RZ, Signal design or pulse shaping for band-limited channels for no intersymbol interference and controlled ISI, Sinc function, Reconstruction filter, Raised cosine spectrum, Filter roll off factor, Data detection for controlled ISI, Eye-pattern.

Probabilistic Detection: Gram Schmidt Orthogonalization procedure, Geometric interpolation of signals, Response of bank of correlators to noisy input, Detection of known signals in noise, Probability of error concepts & criteria of estimation, Maximum likelihood estimation, Union bound on probability of error detection of a single real-valued symbol and detection of a signal vector, A posteriori probability detection, Symbol-error probability for MLSD, Non coherent detection.

Digital Modulation Techniques: Digital modulation formats, Coherent binary modulation techniques, Coherent quadrature-modulation techniques, Comparison of binary and quadratery modulation, Coherent binary ASK, PSK, FSK, QPSK, Non coherent binary modulation techniques, M-ary modulation techniques, Comparison of signal constellations and power spectra analysis, QAM, CPPSK, DPSK, MSK, GMSK, Bandwidth efficiency, Bit error, Bit error vs symbol error probabilities, PLL, DPLL, Direct digital synthesis, ADPLL, Coherent and non-coherent receivers, Correlator, Optimum receiver, Matched filter receiver, Probability of error of the matched filter receiver, Error calculations under AWGN channel for digital modulation techniques.

Digital Transmission: Digital transmission through band limited channels, Digital modulated signals with memory, System design in the presence of channel distortion, Channel equalization: Optimal Zero-Forcing and MMSE equalization, Generalized equalization methods, Fractionally spaced equalizer, Transversal filter equalizers, DFE and error propagation.

Laboratory Work
Practicals based upon hardware using communication kits and simulation with the help of simulation packages.

Text Books
Reference Books

Prerequisite(s): None


DSP Processors: Architecture and instruction set of TMS320C54X DSP Chips, Some example programs.

Laboratory: Calculation of Z, Fourier transform, Design of FIR and IIR filters, Multirate signal processing, realization of prediction, Equalizer and compression algorithms. Some example programs using TMS320C5402.

Text Books

Reference Books
Prerequisite(s): None

**Probability and Induction:** Axioms of Probability, Set Theory, Probability Space, Conditional Probability, Repeated Trials, Combined Experiments, Bernoulli Trials, Bernoulli’s Theorem, and Games of Chance, Concept of a Random Variables, Distribution and Density, Function Specific Random Variables, Conditional Distributions, Binomial Random Variables, Functions of One Random Variable, Its Distribution, Mean and Variance, Moments, Characteristic Functions; Bivariate Distributions, Two Functions of Two Random Variables, Joint Moments, Joint Characteristic Functions, Conditional Distributions, Conditional Expected Values, Normality, Stochastic Convergence and Center Limit Theorem.


**Basics of Information Theory:** Unit of information, Rate of information, Joint entropy and conditional entropy, Mutual information, Shannon-Hartley Theorem, Bandwidth SNR trade off, Channel capacity calculations of different channels.

**Estimation & Hypothesis Testing:** Time and Ensemble Averages, Covariance and Correction Functions. Simple binary hypothesis tests, Decision Criteria, Neyman pearson tests, Bayes Criteria, Multiple Hypothesis testing, Composite hypothesis testing, Asymptotic Error rate of LRT for simple hypothesis testing.

**Queueing Systems:** Characteristics of Queueing Process, Birth-death process, Arrival and service, Steady state solution; M/G/1 and G/M/1, Occupancy distribution, Renewal theory, Waiting time and busy period, Series Queues, Jackson Networks, Cyclic Queues. Little's theorem, Modeling & analysis of M/M/1- queues, Burke's Theorem, Reversibility, Queues with vacations, Work conservation principle, Priority queues, Queues served in cyclic order, Fluid-flow and diffusion approximations.

**Source Coding:** Coding efficiency, Shannon-Fano coding, Huffman coding, Lempel-Ziv adaptive coding.

**Modern Channel Coding Techniques:** Block coding, Convolution coding, Turbo coding, STBC, STTC, Soft-decoding, Hard-decoding and Viterbi decoder.

**Text Books**

**Reference Books**
Introduction to Microprocessors: Need for Flexible Logic and Evolution of Microprocessors, Applications, Generic Architecture of a Microprocessor.


Peripheral Controllers: USART (8251), RS-232C, Programmable Peripheral Interface (8255), Programmable Interrupt Controller (8259), Programmable Timer (8253/8254), Programmable Keyboard and Display Interface, DMA Controller (8257, 8237).

INTEL 8086 Microprocessor: Pin Functions, Architecture, Characteristics and Basic Features of Family, Segmented Memory, Addressing Modes, Instruction Set, Data Transfer Instructions, Arithmetic, Logical, Shift & Rotate Instructions, String Instructions, Flag Control Instructions, Transfer of Control Instructions, Processor Control Instructions, Interrupt Structures, Multitasking and Multiprogramming, Programming Examples.

INTEL 8086 System Configuration: Clock Generator (8284), Bus Controller (8288), MIN/MAX Modes of 8086 and System Configurations.

Interfacing with 8086
Interfacing with RAMs, ROMs along with the explanation of timing diagrams. Interfacing with peripheral ICs like 8255, 8254, 8279, 8259, 8259 etc. Interfacing with key boards, LEDs, LCDs, ADCs, and DACs etc.

Main Memory System Design: Types of Main Memories, Memory Organization, CPU Read/Write Timing Diagrams, RAM and ROM Interface Requirements, DRAM Interfacing and DRAM Controller (8203).

Advanced Microprocessors: Main features, Comparison of 80186, 80286, 80386, 80486 and Pentium processors.

Laboratory Work:
Introduction to INTEL kit, Programming examples of 8085 and 8086. Interfacing using 8085, 8086 kits, Interfacing of LED seven segment display, ADC, DAC, 8253, Printer, UP-PC Interface. Microprocessor based project.

Text Books
Reference Books


Prerequisite(s): None

Electromagnetic Plane Waves: Microwave Frequencies, IEEE microwave frequency bands, Microwave systems and measurements, Electromagnetic plane wave, Electric and magnetic wave equations, Poynting theorem, Uniform plane wave: reflection, Transmission and absorption, Plane wave in a good conductor, Poor conductor and lossy dielectric, Microwave radiation attenuation.


Wave Guides and Resonators: TE, TM Modes in rectangular & Circular wave guides, Wave guide excitation, characteristics impedance of waveguides, Rectangular, Circular and aperture coupling, Excitation of wave guides.

Microwave Tubes and Circuits: High frequency limitations of conventional tubes, Klystrons - two cavity klystron amplifier & oscillator, Multicavity klystron, Reflex klystron, Travelling wave & MW characteristics, Microwave cross-field tube magnetron – operation and MW characteristics, Helix TWT construction, Operation and applications.

Microwave Measurements: General measurement setup, Microwave bench, Power measurement – low, Medium & high, Attenuation measurement, Measurement of VSWR, Measurement of dielectric constant, Measurement of Impedance: using Smith Chart, Measurement with spectrum analyzer, Scalar & vector network analyzer operation, S-parameter and Q measurement.

Microwave Solid State Devices & Their Applications: P-I-N devices, GUNN Diode, IMPATT, SB diodes parametric amplifier.

Laboratory Work
To study the performance of mode characteristics of reflex klystrons circulator, Characteristics of Gunn diode, Directional coupler, Attenuator, Sliding screw tuner, Verify the relation of wavelength, Finding unknown impedance, VSWR measurement, E-plane, H-plane, Magic Tee, Computer based simulation experiments.

Text Books

Reference Books
Prerequisite(s): None

**Integrated Circuits:** Introduction and advantages, Effects of ICs on industry, Scales of integration.

**Growth of Single Crystals of Silicon:** Silicon: Growth from melt using Czochralski’s method, GaAs growth using Bridgerman technique. Intrinsic and doped single crystals. Zone refining.

**Wafer preparation:** Slicing and polishing, Epitaxial layer growth, Defects in epitaxial layers and their removal, Types of epitaxy: VPE, MBE, MOCVD.

**Diffusion:** Impurity diffusion in a semiconductor crystal. Fick’s Laws, Gaussian and Complementary Error Function Distribution of Impurities. Design of junction diode, Transistor, FET and MOSFETs.

**Subsequent Processes:** Oxidation, Ion-implantation, Photolithography etching and metallization, Monolithic and Hybrid I.C’s, Clean room: Standards, Exposure Tools, U.V, Electron beam and X-Ray lithography, +ve & -ve Photo resist.

**MOSFET Technology:** Polysilicon gates and Well Structures.

**Passive Components for I.C’s:** Analog, Linear and Non-linear I.C’s. Digital I.C’s. Digital I.C’s like TTL, ECL, HTL, Video I.C’s, Tuners like 555 and 556: internal circuits and their operation, Ebeam x-ray and ion beam lithography, Etching dry and wet and metalization.

**Packaging of I.C’s:** Mountings in packages using Dual-inl-line (DIP) or TO packages. Packages using surface-mount-technology (SMT).

**Text Books**

**Reference Books**

Basic Antenna parameters: Antenna parameters: Radiation pattern (polarization pattern, Field and phase pattern). Field regions around antenna, Radiation intensity, Beam width. Gain, Directivity, Polarization, Bandwidth, Reciprocity theorem, Efficiency and antenna temperature.

Antenna as a receiver: Effective height, Effective aperture, Power delivered to antenna as a receiver, Input impedance and friss transmission equation Properties of uniform plane waves, Retarded vector and scalar potential. Radiation from an infinitesimal small current element, Radiation from an elementary dipole (Hertzian dipole). Reactive, Induction and radiation fields. Power density and radiation resistance for small current element and half wave dipole in fraunhauffer region

Radiating Wire Structures: Monopole, Dipole, Folded dipole, Loop antenna and Biconical broadband Antenna.

Introduction to Antenna Arrays: Effect of ground on antenna performance (ground as a perfect electric conductor and lossy conductor. Linear Uniform Array of Two & Isotropic sources, Principles of pattern multiplication. Broadside arrays, End fire arrays. Array pattern Synthesis, Uniform Array, Binomial Array. Chebyshev Arrays. Antenna for receiving and transmitting TV signals e.g. Yagi-Uda and Turnstile Antennas.


Antenna Measurements: Antenna range, Radiation pattern, Gain, Directivity, Radiation efficiency, Impedance, Polarization and current measurements.


Computer Based Experiments: Plot of 2D & 3D radiation pattern of short dipole, Halfwave dipole in rectangular as well as polar coordinates. Simulation of beam pattern of broadside, End fire, Binomial, Chebyshev arrays. The simulation can be done using Matlab or Mathematica. Programme for circulating free space path loss.

Text Books
Reference Books

Prerequisite(s): None

Overview of Data Communication and Networking: Data communications, Networks, The Internet, Protocols and standards, Layered tasks, OSI model, TCP/IP protocol Architecture

Physical layer: Analog and digital, Analog signals, Digital signals, Analog versus digital, Data rate limit, Transmission impairments, Line coding, Block coding, Sampling, Transmission mode, Modulation of digital data, Telephone modems, Modulation of analog signal, FDM, WDM, TDM, Guided media, Unguided media, Circuit switching, Telephone networks, DSL technology, Cable modem, SONET.

Data link layer: Types of errors, Detection, Error correction, Flow and error control, Stop and wait ARQ, go back n ARQ, Selective repeat ARQ, HDLC, Point to point protocol, PPP stack, Random access, Controlled access, Channelization, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE802.11, Bluetooth, Connecting devices, Backbone network, Virtual LAN, Cellular telephony, Satellite networks, Virtual circuit switching, Frame relay, ATM.

Network layer: Internetworks, Addressing, Routing, ARP, IP, ICMP, IPV6, Unicast routing, Unicast routing protocol, Multicast routing, Multicast routing protocols

Transport layer: Process to process delivery, User datagram protocol (UDP), Transmission control protocol (TCP), Data traffic, Congestion, Congestion control, Quality of service, Techniques to improve QOS, Integrated services, Differentiated services, QOS in switched networks

Application layer: Client server model, Socket interface, Name space, Domain name space, Distribution of name space, DNS in the internet, Resolution, DNS messages, DDNS, Encapsulation, Electronic mail, File transfer, HTTP, World wide web (WWW), Digitizing audio and video, Audio and video compression, Streaming stored audio/video, Streaming live audio/video, Real time interactive audio/video, Voice over IP


Text Books

Reference Books
Prerequisite(s): None


Programming: Assembly Programming. Timer Registers, Timer Modes, Overflow Flags, Clocking Sources, Timer Counter Interrupts, Baud Rate Generation. Serial Port Register, Modes of Operation, Initialization, Accessing, Multiprocessor Communications, Serial Port Baud Rate.


Introduction to embedded systems: Background and History of Embedded Systems, Definition and Classification, Programming languages for embedded systems: desirable characteristics of programming languages for embedded systems, Low-level versus high-level languages, Main language implementation issues: control, Typing. Major programming languages for embedded systems. Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits.


32-bit RISC Based ARM Architecture: Important features, Instruction set, Programming Examples, Core based Embedded Systems, Soft and Hard Cores, Xilinx FPGA architectures, 8-bit Picoblaze Microcontroller Core, 32-bit Microblaze Soft Core, Power PC

Text Books

Reference Books
Introduction: Introduction to control system and its structure, Feedback and non-feedback systems, Use of feedback automatic control with examples, Basic control signals and Laplace transform.


State Variable Analysis: Introduction, Concept of State, State variables & State models, State Space representation of linear continuous time systems. State variables and linear discrete time systems, Block Diagram for State equation, Transfer function decomposition techniques, Solution of State equations, Concept of Controllability & Observability.

Digital control system: Basic structure of Digital Control systems, Description and analysis of Linear Time-Invariant Discrete-time systems, Description and analysis of Sampled-Data system, Stability analysis of Discrete-time systems, Performance of a Sampled-Data second order system, Closed loop system with digital computer system, Sequential design example.
Text Books

Reference Books
Prerequisite(s): None

Introduction: Course outline, Logistics introduction to ASICS, FPGAs, Economics.

HDL: Logic design Review, Behavior, Dataflow, Structural modeling, Control statements, FSM modeling.

CMOS Review: Classical, CMOS (Deep Sub-micron), ASIC Methodologies (classical) ASIC Methodologies (aggressive).

Fabrication of MOSFET: MOS Transistor, Design methodologies, Design for manufacturability and testability.


Programmable Logic Devices: Types of Programmable Logic Devices, Combinational Logic Examples, PROM - Fixed AND Array and Programmable OR Array, Implementation of Functions using PROM, PLA - Programmable Logic Array (PLA) – Implementation Examples.

Programmable Array Logic: PAL - Programmable Array Logic, Comparison of PROM, PLA and PAL, Implementation of a Function using PAL, Types of PAL Outputs, Device Examples.

Introduction to Sequential Circuits: R-S Latch and Clocked R-S Latch, D Flip Flop, J-K Flip Flop, Master Slave Operation, Edge Triggered Operation.

FPGA: Programmable logic FPGA, Configuration logic blocks, Function Generator, ROM implementation, RAM implementation, Time skew buffers, FPGA Design tools, Network-on-chip, Adaptive System-on-chip.

System Design Examples using FPGA Board: Design Applications using FPGA Board - Traffic Light Controller and Real Time Clock, XSV FPGA Board Features, Testing of FPGA Board, Setting the XSV Board Clock Oscillator Frequency, Downloading Configuration Bit Streams.

Logic synthesis: Fundamentals, Logic synthesis with synopsis, Physical design compilation, Simulation, implementation. Floor planning and placement, Commercial EDA tools for synthesis.

Testing: Advanced interconnects and testing techniques.

Text Book

Reference Books
Prerequisite(s): None


Varactor Diode: Diode theory, Operation and frequency response.

The PIN Diode: p-i-n structure, Device theory. Application of p-i-n diode as a switch and limiter.

The IMPATT Diode: IMPATT theory, Negative resistance, Output frequency and power, IMPATT mountings.

The TRAPPAT Diode: The TRAPPAT structure and operation. Output waveforms, Power and frequency.

The GUNN Oscillator: Gunn effect, Different modes of operation, GUNN and LSA in particular, Output frequency and power.

The Baritt Diode: Device structure, Theory and operation. Applications of the BARITT.

Tunnel Diode: Diode structure, (V-I) characteristics, Operation as a MW generator.

Step Recovery Diode: SRD device structure and operation. SRD as a harmonic generator.

Microwave Transistor: Device geometry, Cutoff frequency and operation, MESFET, HEMT.


Text Books

Reference Books
Prerequisite(s): None

**Optical fiber**: Structures, Wave guiding and Fabrication – Nature of light, Basic optical laws and Definition, Optical fiber modes and Configuration, Mode theory for circular waveguides, Single mode fibers, Graded index fiber, Fiber materials, Fabrication and mechanical properties, Fiber optic cables.

**Signal degradation in optical fibers**: Attenuation, Signal distortion in optical waveguide, Pulse broadening in graded index waveguides, Mode coupling, Design optimization of single mode fibers.

**Optical sources**: Light emitting diodes, Laser diodes, Light source linearity, Modal partition and reflection noise, Reliability consideration.

**Power launching and coupling**: Source to fiber Launching, Lensing schemes for coupling improvement, Fiber to fiber joints, LED coupling to single mode fibers, Fiber splicing, Optical fiber connectors.

**Photodetectors**: Physical properties of photodiodes, Photodetector noise, Response time, Avalanche multiplication noise, Temperature effect on avalanche gain, Photodiode material.

**Optical receiver operation**: Fundamental receiver operation, Digital receiver performance calculation, Preamplifier types, Analog receivers.

**Digital transmission systems**: Point to point links, Line coding, Eye pattern, Noise effects on system performance. Analog system: Overview of analog links, Carrier to noise ratio, Multichannel transmission techniques.

**Coherent optical fiber communication**: Classification of coherent system, Requirements on semiconductor lasers, Modulation techniques, Modulation techniques, Polarization control requirements.

**Advanced systems and techniques**: WDM, LAN, Optical amplifiers, Photonic switching, Nonlinear optical effects.

**Laboratory work**

Basic optical communication link experiments (analog & digital), measurement of numerical aperture, splicing, multiplexing experiments, bending losses, measurement with OTDR, design and performance analysis using simulation tools.

**Text Books**


**Reference Books**

**UEC803 RADAR, SATELLITE AND NAVIGATIONAL AIDS**

**Prerequisite(s): None**


Text Books

Reference Books
Prerequisite(s): None


**Modern Wireless Communication Systems:** Second Generation (2G) Cellular Networks. Third Generation (3G) Wireless Networks. Wireless Local Loop (WLL) and LMDS. Wireless Local Area Networks (WLANs). Bluetooth and Personal Area Networks (PANs).


**Spread Spectrum:** Spread spectrum modulation techniques, codes: Gold, Walsh, Kasomi short and long codes, Pseudo-noise sequence, Direct sequence spread spectrum (DS-SS), Frequency hopped spread spectrum (FHSS), Performance of DS-SS, Performance of FH-SS, Modulation performance in fading and multipath channels.

**Wireless Signal detection and estimation:** Diversity Techniques, Combiner analysis, RAKE Receiver, Algorithms for adaptive equalization, Detection and estimation algorithms.
Current and upcoming wireless systems: Third generation systems UMTS, IMT 2000. Bluetooth system. The future of mobile communications. 3G, 4G, 802.11a/b/g, 802.16, concepts of Adhoc networks and mobile computing.

Text Books

Reference Books


Digital Representation: Linear quantization, Companding, Optimum quantization, Pulse code modulation effects of channel errors, Vector quantization (VQ), Adaptive quantization, Differential PCM, APCM vs. ADPCM, Delta modulation, Adaptive delta modulation.

Digital Vocoder: Linear predictive coding (LPC), Hybrid coders: voice excited vocoders, Voice excited linear predictor

Speech Recognition: Isolated word recognition, Continuous speech recognition, Speaker (in) dependent, Measures and dynamic time warping (DTW), HMM, Viterbi algorithm, Discrete and continuous observation density HMMs.

Speaker recognition: Speaker verification/authentication vs. speaker identification, Closed vs. open set, Feature vectors, Pattern matching, Hypothesis testing, And errors.

Text Books

Reference Books
UEC612 DIGITAL SYSTEMS DESIGN

L  T  P  Cr
3  1  2  4.5

Prerequisite(s): None

Combinational Logic: Review of adders, Subtractor, Multipliers, Multiplexers, ROM, PLA, PAL and PLD.


Finite State Machines: Finite state model, Memory elements and their excitation functions, Synthesis of Synchronous sequential circuits, Capabilities and limitations of FSM, Design, Modeling and Simulation of Moore and Mealy machines.

Algorithmic State Machines: ASM chart, Timing considerations, Control implementation, Control Design with multiplexers, PLAs, etc.

Asynchronous Sequential Logic: Analysis Procedure, Circuits with latches, Design procedure, Reduction of state and flow tables, Race-free state assignment, Hazards, Design examples.

VHDL: Lexical elements, Behavioral, Dataflow and Structural Modeling, Generics and Configuration, Subprograms and Overloading, Operator overloading, Package declaration, Package body, design Libraries, Generate statements, Qualified expressions, Type conversions, Guarded signals, Attributes, Aggregate targets, Test Bench.

Design of networks for Arithmetic and logical operations: Representation of fixed-point and floating-point numbers and their operations, ALU, Serial adder, Binary multiplier, Binary divider.

Designing with Programmable Logic Devices and Programmable Gate Arrays: Read only memories, Programmable logic arrays, Programmable array logic, Designing with FPGAs, Xilinx series FPGAs

Laboratory Work
Design of flip-flops, Counters, Registers, Multiplexers, Decoders, Demultiplexers, State machines using hardware description language at various abstraction levels, Functional simulation of VHDL designs by applying stringent timing constraints, Creating test benches.

Text Books

Reference Books
Prerequisite(s): None


Active Filters and Oscillators: Active Filters: Butterworth Filters, Band-Pass Filters, Band Reject Filters, All Pass Filters. Oscillators and Wave Generators: Phase Shift Oscillator, Wien Bridge Oscillator, Voltage-Controlled Oscillator (VCO), Square Wave Generator, Triangular Wave Generator, Saw-tooth Wave Generator.

Specialized IC Applications: Introduction, Universal Active Filter, The 555 Timer, Monostable and Astable Multivibrator using IC 555, Phase-Locked Loop (PLL), Voltage Regulators.

Text Books

Reference Books
Basic telephony, ISO-OSI reference model, Concepts of switching, Transmission, Multiplexing and concentration.

**Evolution of Tele-Communication**: Basic Switching System, Simple Tele-phone Communication, Telephone Transmitter, Telephone receiver, Telephone’s bell & dialer pulsing mechanism, Subscribers telephone sets, Dialing types, Signaling tones, Brief introduction to electromagnetic exchanges, Concept of tone dialing and DTMF.

**Introduction to Switching Systems**: General principle of switching, Electronic space division switching – stored program control – time division switching – time multiplexed space switching – time multiplexed time switching – two stage, Three stage and N-stage combination switching, Signaling and control, Centralized and decentralized SPC, Enhanced services, Blocking and non-blocking switches, TDM, TSI and TMS circuits, Circuit switching, Virtual-circuit/label switching; crossbar/bus/shared memory switches, Ethernet switches at edge and metro; switching characteristics of interconnection networks, Parallel switching control in sorting, Concentration, Multicasting and distribution, Blocking probability analysis of multistage switches – lee approximation - improved approximate analysis of blocking switch – examples of digital switching systems – AT & T 5ESS and NTI – DMS 100 switching systems.


Text Books


Reference Books

UEC621 CMOS CIRCUIT DESIGN

Prerequisite(s): None

MOS Transistor Theory: Introduction to MOS Physics, MOSFET Work Function MOS Models, MOSFET Structure and Operation: Accumulation, Depletion and Inversion region; Weak and Strong Inversion, Threshold voltage, Current-Voltage characteristics, Body effect, MOSFET Scaling theory, Limits of miniaturization, Small geometry effects.


Combinational Circuits: MOS Logic Circuits with Depletion NMOS loads, CMOS Logic Circuits, CMOS logic Styles, Realization of simple gates, Complex logic circuits, Pass Gate, Transmission Gate.


Subsystem Design: Adders, Shifters, ALU, High Performance Dynamic CMOS Circuits, ROM and PLA structures, Static and Dynamic RAM Circuits.

VLSI Design Methodologies: Design Strategies, Design flow, Semi-custom and full-custom design methodology, Concept of Cell Library, Gate Array Based Design, FPGA, Use of CAD tools, CMOS chip design options.

Introduction to low Power CMOS Logic Circuits.

Laboratory work

Familiarization with Circuit design/simulation tools (Cadence/Mentor/Tanner Tools) for schematic and layout entry, Circuit simulation using SPICE. DC transfer Characteristics of Inverters, Transient response, Calculating propagation delays, rise and fall times, Circuit design of inverters, Complex gates with given constraints. Circuit Simulation and Performance Estimation using SPICE. Layouts of Inverters & Complex gates, Layout Optimization, Design Rule Check (DRC), Electrical Rule Check (ERC), Comparison of Layout vs. Schematics, Circuit Extraction. A project based on the above exercises.

Text Books:

Reference Books:

Prerequisite(s): None

**An Introduction to DSP Processors:** Advantages of DSP, Characteristics of DSP systems, Classes of DSP applications, DSP processor embodiment and alternatives, Fixed Vs Floating point processors, Fixed point and Floating point Data Paths.

**DSP Architecture:** An introduction to Harvard Architecture, Differentiation between Von-Neumann and Harvard Architecture, Quantization and finite word length effects, Bus Structure, Central Processing Unit, ALU, Accumulators, Barrel Shifters, MAC unit, Compare, Select, and store unit (CSSU), Data addressing and program memory addressing.

**Memory Architecture:** Memory structures, Features for reducing memory access required, Wait states, External memory interfaces, Memory mapping, Data memory, Program memory and I/O memory, Memory mapped registers.

**Addressing:** Various addressing modes – implied addressing, Immediate data addressing, Memory direct addressing, Register direct and indirect addressing, And short addressing modes.

**Instruction Set:** Instruction types, Various types registers, Orthogonality, Assembly language and application development.

**Execution Control and Pipelining:** Hardware looping, Interrupts, Stacks, Pipelining and performance, Pipelining depth, Interlocking, Branching effects, Interrupt effects, Instruction pipelining.

**Peripherals:** Serial ports, Timers, parallel ports, Bit I/O port, Host ports, Communication ports, On-chip A/D and D/A converters, External interrupts, On chip debugging facilities, Power consumption and management.

**Processors:** Architecture and instruction set of TMS320C3X, TMS320C5X, TMS320C6X, ADSP 21XX DSP Chips, Some example programs.

**Recent Trends in DSP System Design:** FPGA-Based DSP System Design, Advanced development tools for FPGA, Development tools for Programmable DSPs an introduction to Code Composer Studio.

**Text Books**

**Reference Books**

Prerequisite(s): None

Introduction to ASICs and FPGAs: Fundamentals in digital IC design, FPGA & CPLD Architectures, FPGA Programming Technologies, FPGA Logic Cell Structures, FPGA Programmable Interconnect and I/O Ports.


Laboratory Work
1. Three labs will be assigned. One lab is targeted to get familiar with Xilinx ISE EDA tools and Spartan prototype board. The second lab is designed for practicing FPGA design flow with Verilog/VHDL. The third is in the area of distributed arithmetic circuits.
2. The class project is to implement a digital low-pass filter.
3. Groups need to be formed to carry out labs and the project. Each group can at most have two students.

Textbooks

Reference Books

Xilinx User Manuals and Application Notes
Prerequisite(s): None

**History & Introduction:** Biological Neural networks and simple models, The Artificial Neuron model, Why Artificial Networks, Characteristics of Neural Networks, Historical perspectives, The biological prototype, Neuron, Synapses and dendrites, Single and Multi layer neural networks, Their variants and Applications Terminology, Notations and representation of Neural Networks, Types of activation functions.

**Neural Network Architectures:** Fully connected, Layered, Cyclic feed forward.

**Neural learning:** Correlation, Competitive, Feedback based weight adaptation, Evaluation of networks; Quality of results, generalizability, Computational resources.

**Training of Neural Networks:** Supervised and Unsupervised Learning, Categorization using ANNs.

**Perceptrons:** History, Representation of perceptrons and issues, Perceptron learning and training.

**Back propagation:** Concept, Back propagation training algorithm, Applications of Back propagation.

**Counter propagation networks:** Introduction and structure, Layers and their training, Application of counter propagation.

**Hopfield nets:** Energy functions and Optimization Bi-directional Associative memories, Optical neural networks, Yhe cognitron and Neo-cognitron, Structure and training, Competitive Learning, Feature Mapping, Self Organizing Maps.

**Adaptive Resonance Theory:** Stability -V Plasticity dilemma, ART1 & ART2. Hardware realization of ANNs. Recent trends and Future Directions.


**Neuro Fuzzy Modeling:** Adaptive Neuro-Fuzzy Inference Systems, Architecture. Hybrid Learning

**Fuzzy-GA Systems:** Architecture, Learning Algorithm, Inference systems and Modeling.

**Applications Of Computational Intelligence:** Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction.

**Laboratory Work:**
Lab experiments based on MATLAB Neural and Fuzzy Toolboxes.

**Text Books**

**Reference Books**


Prolog: Basic constructs, Answer extraction

Bayesian Reasoning: Bayesian networks, Dynamic Bayesian networks

Planning: State-space search, Planning graphs


Expert Systems: Expert systems: advantages, Disadvantages, Expert system architecture, Functions of various parts, Mechanism and role of inference engine, Types of Expert system, Tuning of expert systems, Role of Expert systems in instrumentation and process control


Text Books


Reference Books
Prerequisite(s): None


Fundamental devices and processes: Multi User MEMS Process (MUMPs), SUMMiT: design rules; applications; micro hinges and deployment actuators, CMOS MEMS, Cleanroom lab techniques, MicroOptoElectroMechanical Systems (MOEMS), BioMEMS and biomaterials, Piezoresistivity; Scanning probe microscopy, Scaling laws, applications. Lumped element modeling and design, Electrostatic Actuators, Electromagnetic Actuators, Linear and nonlinear system dynamics, Resonant systems, Elasticity (stress, Strain, Material properties), Mechanical structure basics (bending of beams, Torsion, Natural frequency), Optical system design basics (Gaussian beam optics, Matrix optics, Resolution)

Application case studies: MEMS Scanners and Retinal Scanning Displays (RSD), Grating Light Valve (GLV), Digital Micromirror Devices (DMD), Optical switching, Capacitive Micromachined Ultrasonic Transducers (CMUT)

Text Books

Reference Books

Optimization of System Reliability: Optimization techniques for systems reliability with redundancy, Heuristic methods applied to optimal system reliability, Dynamic programming applied to optimal system reliability, Discrete maximum principle applied to optimal, System reliability, Sequential unconstrained minimization techniques, Generalized reduced gradient method, Method of Lagrangain multiplier and Kuhn-tuejer conditions applied to optimal system reliability, Generalized Lagrangian function, Geometric and integer programming methods applied to optimal system reliability. Other methods to system reliability optimization problems, Determination of component reliability and redundancy for optimum system reliability.


Life Testing and Reliability Estimation: Point and interval estimation procedure for life time distributions, Testing reliability hypotheses, Bayes methods in reliability, Design and analysis of life test experiments, Accelerated life testing, Non-parametric methods, Non-destructive tests, Destruction tests and their mathematic modeling, Quality and reliability, Measurement & prediction of human reliability, Reliability and safety, Safety margins in critical devices, Case studies, Value engineering: Techniques in value engineering, Structure of value engineering, Reliability management.

Text Books

Reference Books
Introduction: Introduction to DSP Systems, Terminating and Non-Terminating, Representation of DSP programs, Data Flow graphs (DFGs), Single rate and multi rate DFGs, Iteration bound, Loop, Loop Bound, Iteration rate, Critical loop, Critical path, Area-Speed-Power trade-offs, Precedence constraints, Acyclic Precedence graph, Longest Path Matrix (LPM) and Minimum Cycle Mean (MCM) Algorithms, Pipelining and parallel processing of DSP Systems.


Systolic Architecture Design and Fast Convolution: Systolic architecture design methodology, Projection vector, Processor Space vector, Scheduling vector, Hardware Utilization efficiency, Cook-Toom Algorithm, Iterated Convolution, Cyclic Convolution.


Text Books

Reference Books
Prerequisite(s): None

Physical and Wireless Mac Layer Alternatives: Wired transmission techniques: Design of wireless modems, Power efficiency, Out of band radiation, Applied wireless transmission techniques, Short distance base band transmission, VWB pulse transmission, Broad Modems for higher speeds, Diversity and smart receiving techniques, Random access for data oriented networks, Integration of voice and data traffic.

Wireless Network Planning and Operation: Wireless networks topologies, Cellular topology, Cell fundamentals signal to interference ratio calculation, Capacity expansion techniques, Cell splitting, Use of directional antennas for cell sectoring, micro cell method, Overload cells, Channels allocation techniques and capacity expansion FCA, Channel borrowing techniques, DCA, Mobility management, Radio resources and power management securities in wireless networks.

Wireless WAN: Mechanism to support a mobile environment, Communication in the infrastructure, IS-95 CDMA forward channel, IS – 95 CDMA reverse channel, Pallert and frame formats in IS – 95, IMT – 2000; forward channel in W-CDMA and CDMA 2000, Reverse channels in W-CDMA and CDMA-2000, GPRS and higher data rates, Short messaging service in GPRS mobile application protocols.

Wireless LAN: Historical overviews of the LAN industry, Evolution of the WLAN industry, Wireless home networking, IEEE 802.11. The PHY Layer, MAC Layer, Wireless ATM, HYPER LAN, HYPER LAN

Wpan and Geolocation Systems: IEEE 802.15 WPAN, Home RF, Bluetooth, Interface between Bluetooth and 802.11, Wireless geo location technologies for wireless geo location, Geo location standards for E.911 service.

Text Books

Reference Books
Prerequisite(s): None


Text Books

Reference Books