UES007 SEMICONDUCTOR DEVICES

L	T	P	Cr
3	1	2	4.5

Prerequisite(s): None

Semiconductor Physics: Energy bands in solids (Metals, Semiconductor, Insulators), Drift current, Diffusion Currents, Intrinsic, Extrinsic semiconductor, Mass action law, Charge densities, Conductivity of metals and semiconductors, Concept of Fermi levels in Intrinsic and Extrinsic semiconductor, Concept of degenerative doping, Compensated semiconductor.

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, f_α, f_β and f_T-parameters in terms of current gain, Transistor amplifier parameters using r_e 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.
4. Switching Characteristics of Diode and Transistor.
5. MOSFET characteristics, and evaluation of μ, g_m and r_d. verify $\mu = g_m * r_d$.
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.
9. Bridge rectifier and Estimation of ripple factor.

Text Books

1. *Milliman, J. and Halkias, C.C., Electronic Devices and Circuits, Tata McGraw Hill (2007) 2nd ed.*
2. *Boylestad, R.L. and Nashelsky, L., Electronic Devices & Circuit Theory, Perason Education (2007) 9th ed.*

Reference Books

1. *Malvino, L., Electronic principles, Tata McGraw Hill (1998) 5th ed.*
2. *Milliman, J. and Halkias, C. C., Intergrated Electronics, Tata McGraw Hill (2007) 2nd ed.*

UEC301 ANALOG ELECTRONIC CIRCUITS

L	T	P	Cr
3	1	2	4.5

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-vibratotrs (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.

Linear Integrated Circuits and Applications: Differential Amplifiers Basic of Differential Amplifier, Transistorized differential Amplifier, Configurations of Differential Amplifier, Analysis of Dual Input Balanced Output Differential Amplifier, Constant Current Bias, Current Mirror Circuit, Cascading of Differential Amplifiers.

Laboratory Work

1. Frequency response analysis of RC coupled amplifier.
2. Frequency response analysis of Tuned amplifiers.
3. Push-pull amplifier.
4. SCR Chracterstics.
5. Frequency response analysis of Feedback amplifier.
6. Hartley and Colpitts Oscillator.
7. RC Phase shift oscillator.
8. Study of Multi-vibrators (Astable, Mono-stable, Bi-stable Multi-vibrator).
9. Clipper and Clamper circuit.
10. Schmitt Trigger.

Text Books

1. *Milliman, J. and Halkias, C.C., Intergrated Electronics, Tata McGraw Hill (2007) 2nd ed.*
2. *Milliman, J. & Taub, H., Pulse, Digital and switching waveforms, Tata McGraw Hill (2007) 3rd ed.*

Reference Books

1. *Malvino, L., Electronic principles, Tata McGraw Hill (1998) 5th ed.*
2. *Cathey, J. J., 2000 Solved Examples in Electronics, McGraw Hill (1991) 4th ed.*

UEC302 DIGITAL ELECTRONIC CIRCUITS

L	T	P	Cr
3	1	2	4.5

Prerequisite(s): None

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

Combinational circuits: Simplification of Boolean functions by K-map method and Q. M. method, Half adder, Full adder, BCD adder, High speed adder, Subtractor, Multiplier, Dividers, ALU, Code conversion, Magnitude comparators, Encoders, Decoders, Multiplexers, Demultiplexer, Application of Encoders, Decoders, MUX, DEMUX, Implementations using ROM, PLA, PAL, Standard ICs for their applications.

Sequential circuits: Various types of flip-flops and their conversions, Registers, Counters – Ring, Jonson, 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

1. *Mano, M.M., Digital Design, Prentice Hall (2001) 3rd ed.*
2. *Tocci, R.J., Digital Systems: Principles and Applications, Prentice-Hall (2006) 10th ed.*

Reference Books

1. *Wakerly, J.F., Digital Design Principles and Practices, Prentice Hall of India (2006) 3rd ed.*
2. *Fletcher, W.I., Engineering Approach to Digital Design, Prentice Hall of India (2007) 4th ed.*

UEC401 ANALOG COMMUNICATION SYSTEMS

L	T	P	Cr
3	1	2	4.5

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 hetro-dyne receiver, AM receiver using a phase locked loop (PLL), AM receiver characteristics.

FM Transmission: FM allocation standards, Generation of FM by direct method, Varactor diode Modulator, Indirect generation of FM, The Armstrong method RC phase shift method, Frequency stabilized reactance FM transmitter, FM stereo transmitter, Noise triangle.

FM Reception: Direct methods of Frequency demodulation, Travis detector/frequency discrimination (Balanced stop detector), Foster seely 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 Transmission: Introduction, Advantages of SSB Transmission, Generation of SSB, The Filter method The Phase Shift Method, The Third Method, AM Compatible SSB Modulation, Pilot Carrier SSB, Independent Side-band Systems (ISB), Vestigial Side-band Modulation (VSB), VSB-SC, Application of AM and FM in TV transmission.

SSB Reception: SSB Product Demodulator, Balanced Modulator as SSB Demodulator, Pilot Carrier SSB Receiver, SSB Double Super-hetrodyne 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

1. *Proakis, J. G. and Salehi, M., Fundamentals of Communication Systems, Dorling Kindersley (2008) 2nd ed.*
2. *Kennedy, G., Electronic Communication Systems, McGraw-Hill (2008) 4th ed.*

Reference Books

1. *Taub, H., Principles of Communication Systems, McGraw-Hill (2008) 3rd ed.*
2. *Haykin, S., Communication Systems, John Willey (2009) 4th ed.*

UEC402 COMPUTER ARCHITECURE

L	T	P	Cr
3	1	0	3.5

Prerequisite(s): None

Fundamentals of Computer Design: Historical Perspective, Computer Types, Von-Neuman Architecture, Harward Architecture Functional Units, Basic Operational Concepts, Bus Structures, Performance metrics, CISC and RISC architectures, Control Unit, Hardwired and micro-programmed Control unit.

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.

Memory Hierarchy Design: Introduction, Cache memory, Cache Organization, Write Policies, Reducing Cache Misses, Cache Associativity Techniques, Reducing Cache Miss Penalty, Reducing Hit Time, Main Memory Technology, Fast Address Translation, Translation Lookaside buffer Virtual memory, Crosscutting issues in the design of Memory Hierarchies.

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

Input/Output Organization and Buses: Accessing I/O Devices, Interrupts, Handling Multiple Devices, Controlling device Requests, Exceptions, Direct Memory Access, Bus arbitration policies, Synchronous and Asynchronous buses, Parallel port, Serial port, Standard I/O interfaces, Peripheral Component Interconnect (PCI) bus and its architecture, SCSI Bus, Universal Synchronous Bus (USB) Interface.

Text Books

1. *Hennessy, J. L., Patterson, D. A., Computer Architecture: A Quantitative Approach, Elsevier (2009) 4th ed.*
2. *Hamacher, V., Carl, Vranesic, Z.G. and Zaky, S.G., Computer Organization, McGraw-Hill (2002) 2nd ed.*

Reference Books

1. *Murdocca, M. J. and Heuring, V.P., Principles of Computer Architecture, Prentice Hall (1999) 3rd ed.*
2. *Stephen, A.S., Halstead, R. H., Computation Structure, MIT Press (1999) 2nd ed.*

UEC403 CIRCUIT ANALYSIS AND SYNTHESIS

L	T	P	Cr
3	1	0	3.5

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.

Attenuators: Image impedances-Image transfer coeff, Iterative impedances, Ladder network, Lattice network, Bridged T-network conversion, Insertion loss, Design of symmetrical-T & L section Attenuators.

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 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

1. *Vanvalkenberg, M.E., Networks Analysis, Prentice Hall of India (2007) 3rd ed.*
2. *Arshad, M., Network Analysis and Synthesis, Laxmi Publications (2008) 2nd ed.*

Reference Books

1. *Kuo, F., Network Analysis and Synthesis, John Wiley (2003) 2nd ed.*
2. *Anderson, B.D.O., Vongpanitlerd, S., Network Analysis and Synthesis, Dover Publications (2006) 3rd ed.*

UEC404 SIGNALS AND SYSTEMS

L	T	P	Cr
3	1	2	4.5

Prerequisite(s): None

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.

Random Signals: Probability, Random variables, Gaussian distribution, Transformation of random variables, Random processes, Stationary processes, Correlation and Covariance Functions, Regularity and Ergodicity, Gaussian Process, Transmission of deterministic and undeterministic signals through a linear time invariant system, Spectral density.

Laboratory work

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

Text Books

1. *Oppenheim, A.V. and Willsky, A.S., Signal & Systems, Prentice Hall of India (1997) 2nd ed.*
2. *Proakis, J.G. and Manolakis, D.G., Digital Signal Processing Principles Algorithm & Applications, Prentice Hall (2007) 4th ed.*

Reference Books

1. *Lathi, B.P., Modern Digital and Analog Communication Systems, Oxford Univ. Press (1998) 3rd ed.*
2. *Papoulis, A., Probability Random Variables and Stochastic Processes, McGraw Hill (2008) 2nd ed.*

UEC501 DIGITAL COMMUNICATION SYSTEMS

L	T	P	Cr
3	1	2	4.5

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, O/P signal to 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

1. *Proakis John G., Digital Communication System, McGraw, (2000) 4th ed.*
2. *Simon Haylein, Digital Communication Systems, Wiley India edition, (2009) 2nd ed.*

Reference Books

1. *Taub & Schilling, Principles of Communication Systems, McGraw Hill Publications, (1998) 2nd ed.*
2. *Simon Haykin, Communication Systems, John Wiley Publication, 3rd ed.*
3. *Sklar, Digital Communications, Prentice Hall-PTR, (2001) 2nd ed.*
4. *Lathi B. P., Modern Analog and Digital Communication, , Oxford University Press, (1998) 3rd ed.*

UEC502 DIGITAL SIGNAL PROCESSING

L	T	P	Cr
3	1	2	4.5

Prerequisite(s): None

Review of Z transforms, Continuous and discrete time Fourier Series and Fourier Transforms, Discrete Fourier Transform, Divide and Conquer Algorithm, Decimation-in-Time and Decimation-in-Frequency FFT Algorithms.

Design of digital filters: Design of FIR Filters, Symmetrical, Asymmetrical FIR Filters, Window Methods - Rectangular, Traingular, Hamming, Hanning, Blackman, Kaiser Window etc, IIR filters using analog approximations, Multirate digital signal processing, Decimation and interpolation, Sample rate conversion, Efficient polyphase structures, Design of phase shifters, Filter banks, Quadrature mirror filters.

Estimation and Prediction: Linear prediction and optimum linear filters, Forward & backward linear prediction, Levinson-Durbin Algorithm, Schur algorithm, Properties of linear prediction error filters, Wiener filters for filtering.

Equalization Algorithms: Adaptive Equalizer, The Zero-Forcing Algorithm, Decision Feedback Equalizer, Block Decision Feedback Equalizer, The LMS algorithm Convergence properties of the LMS algorithm, The recursive least Squares Algorithm Kalman filtering, Blind equalization.

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

1. *Proakis, J.G., Digital Filters: Analysis, Design and Application, McGraw Hill (1981) 2nd ed.*
2. *Proakis, J.G., and Manolakis, D.G., Digital Signal Processing, PHI (2001) 3rd ed.*

Reference Books

1. *Antonion, Andrea,s "Digital Filters, Analysis, Design and Applications, McGraw Hill (2000) 2nd ed.*
2. *Oppenheim, A.V., and Schafer, R.W., Discrete-Time Signal Processing, Pearson (2002) 2nd ed.*
3. *Rabiner, C.R., and B. Gold, Theory and Applications of signal processing, PHI (1990) 4th ed.*
4. *Mitra , S. K., Digital Signal Processing: A computer based approach, Tata McGraw Hill (1996) 4th ed.*

UEC503 INFORMATION THEORY AND CODING

L	T	P	Cr
3	1	0	3.5

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.

Stochastic Processes: Systems with Stochastic Inputs, Power Spectrum, Random Walks and Poisson Points, Cyclostationary Processes, Bandlimited Processes and Sampling Theory, Deterministic Signals in Noise Bispectra and System Identification, Poisson Sum Formula, Schwarz Inequality Problems, Spectral Representation of Random Processes, Factorization and Innovations, Finite-Order Systems and State Variables, Karhunen–Lo`eve Expansions, Ergodicity, Extrapolating Spectra and Youla's Parametrization, Minimum-Phase Functions, All-Pass Functions, Mean Square Estimation, Entropy, Maximum Entropy Method, Markov Chains, Higher Transition Probabilities and Chapman–Kolmogorov Equation, Stationary Distributions and Limiting Probabilities, Transient States and Absorption Probabilities, Branching Processes, Mixed Type Population of Constant Size, Structure of Periodic Chains.

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-/- 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

1. *Athanasios Papoulis, Probability Random Variables and Stochastic Processes, McGraw-Hill (1984) 4th ed.*

2. *Daigle, John N., Queueing theory with applications to packet telecommunication Springer (2005) 2nd ed.*
3. *Proakis, John G., Digital Communications, McGraw-Hill (1995)3rd edition*

Reference Books

1. *Peebles, P.Z., Probability, random variables, and random signal principles, McGraw-Hill (1980) 2nd ed.*
2. *Bertsekas, Dimitri P., Gallager, Robert G., Data networks, Prentice-Hall (1987) 4th ed.*
3. *Larson, A. and Schubert, B. O., Stochastic Processes, vol. I and II, Holden-Day (1979) 5th ed.*
4. *Gardener, W., Stochastic Processes, McGraw Hill (1986) 2nd ed.*

UEC504 MICROPROCESSORS

L	T	P	Cr
3	1	2	4.5

Prerequisite(s): None

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

INTEL 8085 Microprocessor: Pin Functions, Architecture, Addressing Modes, Instruction Set, Timing Diagrams, Interrupts, Programming Examples.

Basic Input/Output Techniques: Serial I/O, Parallel I/O, Programmed I/O, Interrupt Driven I/O, Direct Memory Access.

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

1. *Gaonkar, Ramesh., Microprocessor Architecture, Programming and Applications with the 8085, Penram International Publishing India PVT.LTD. (2005) 5th Ed.*
2. *Hall, D.V., Microprocessor and Interfacing, Tata McGraw Hill Publishing Company, (2006) 2nd ed.*

Reference Books

1. *Rafiquzzaman, M., Microprocessors and. Microcomputer-Based System Design, CRC Press, (1995) 2nd ed.*
2. *Gibson, Glenn A., Liu, Yu-Cheng., Microcomputer Systems: The 8086/8088 Family Architecture Programming And Design, Pearson, (2001) Ist ed.*

UEC505 MICROWAVE ENGINEERING

L	T	P	Cr
3	1	2	4.5

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.

Microwave Components: Waveguide Microwave Junctions, Scattering matrix and their properties, Microwave T junctions – H Plane Tee, E Plane Tee Rat Race Junction, Directional coupler – Two hole directional coupler, Single hole coupler and scattering matrix of a directional coupler, Waveguide joints, Bends, Corners, Transition & twists, Coupling probes & loops, Waveguide terminations, Reentrant cavities, Ferrite devices – faraday rotation in devices, Circulator & isolator, Microwave filter – YIG filter resonators, Phase shifters and microwave attenuators.

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

1. *Liao, S.Y., Microwave Devices & Circuits, Tata McGraw Hill (2006) 2nd edition.*
2. *Collins, Robert, Foundation of Microwave Engineering, McGraw Hill (2005) 3rd edition.*

Reference Books

1. *Wolf E.A., and kaul, R.., Microwave Engineering & Systems Applications, Wiley Interscience (2002) 4th edition.*
2. *Sze, S. M., Physics of Semiconductor Devices, Wiley Eastern (2003) 2nd edition.*
3. *Sarvate, V.V., Electromagnetic Fields & Waves, John Wiley & Sons (2004) 3rd edition.*

UEC506 MICROELECTRONICS –IC DESIGN & FAB

L	T	P	Cr
3	1	0	3.5

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

1. *Sze, S. M., VLSI Technology, Wiley Eastern, USA (1999) 2nd ed.*
2. *Sze, S. M., Semiconductor Devices, Physics & Technology, (2001) 3rd ed.*

Reference Books

1. *Pucknell and Eshraghian, Basic VLSI Design, (2000) 2nd edition*
2. *Nagchoudhri, D., Principles of Microelectronics Technology (2002) 4th edition.*

UEC601 ANTENNA THEORY AND WAVE PROPAGATION

L	T	P	Cr
3	1	2	4.5

Prerequisite(s): None

Introduction: Antenna as an element of wireless communication system, Antenna radiation mechanism, Types of antennas, Fundamentals of EMFT: Maxwell's equations and their applications to antennas, Review of vector theory, Del operator, Gradient, Divergence & curl, Coordinate system: Rectangular, Cylindrical, Spherical and their transformation.

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.

Aperture Type Antennas: Aperture Antennas, E & H -plane Horns, Pyramidal Horn. Lens Antenna and Reflector Antennas, Frequency Independent Antennas: Log Periodic Antenna, Microstrip Antennas & their advantages.

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

Propagation of Radio Waves: Different modes of propagation: Ground waves, Space waves, Space wave propagation over flat and curved earth, Optical and radio horizons, Surface waves and Troposphere waves. Ionosphere, Wave propagation in the Ionosphere. Critical frequency, Maximum usable frequency (MUF), Skips distance. Virtual height. Radio noise of terrestrial and extraterrestrial origin.

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

1. *Ballanis, Antenna Theory, John Wiley & Sons, (2003) 2nd ed.*
2. *Jordan and Balmain, E.C., Electro Magnetic Waves and Radiating Systems, PHI, 1968 Reprint (2003) 3rd ed*

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Reference Books

1. *Kraus and Ronalatory Marhefka, John D., Antennas, Tata McGraw-Hill Book Company, (2002) 2nd ed.*
2. *Collins, R. E., Antennas and Radio Propagation, McGraw-Hill, (1987) 4th ed.*

UEC602 DATA COMMUNICATION

L	T	P	Cr
3	1	0	3.5

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

Switching: Circuit Switching Networks, Concepts, Control Signaling, Softswitch Architecture, Packet switching, Packet size, X.25, Frame Relay, ATM, Message Switching.

Text Books

1. *Ferouzan, Behrouz A., Data Communications and Networking, TATA McGraw Hill (2002) 2nd ed.*
2. *Stallings William, Data and Computer Communication, Pearson Education (2000) 7th ed.*

Reference Books

1. *Black, Ulylers D., Data Communication and Distributed Networks, PHI (1999) 3rd ed.*
2. *Tanenbaum, Andrew S., Computer Networks, PHI (2000) 2nd ed.*

UEC603 MICROCONTROLLERS & EMBEDDED SYSTEMS

L	T	P	Cr
3	1	2	4.5

Prerequisite(s): None

Microcontroller: Introduction to Microcontrollers, Evolution, Microprocessors vs. Microcontrollers, MCS-51 Family Overview, Important Features, Architecture. 8051 Pin Functions, Architecture, Addressing Modes, Instruction Set, Instruction Types.

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.

Interrupts: Interrupt Organization, Processing Interrupts, Serial Port Interrupts, External Interrupts, Interrupt Service Routines. Microcontroller Specification, Microcontroller Design, Testing, Timing Subroutines, Look-up Tables, Serial Data Transmission.

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.

Real Time Operating Systems (RTOS): Architecture of an RTOS, Important features of VxWorks and Montavista Linux, Embedded Systems Programming, Locks and Semaphores, Operating System Timers and Interrupts, Exceptions, Tasks: Introduction, Defining a task, Task states and scheduling, Task structures, Synchronization, Communication and concurrency, Kernel objects: Semaphores, Queues, Pipes, Event registers, Signals, And condition variables. Real-time clock and system clock, Programmable interval timers, Timer ISRs, Timing wheels, Soft timers.

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

1. *Mckenzie, Scott, The 8051 Microcontroller, PHIs, (1995) 5th ed.*
2. *Simon, David E., An Embedded System Primer, Pearson Education, (2005) 4th ed.*

Reference Books

1. *Ayala, Kenneth J., The 8051 Microcontroller: Architecture, Programming, and Application, (2008) 2nd ed.*

UEC604 MODERN CONTROLTHEORY

L	T	P	Cr
3	1	0	3.5

Prerequisite(s): None

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.

Mathematical Models of Systems: Introduction, General aspects of Mathematical models, Types of Mathematical models, Differential equations of physical systems, Transfer function for electronic networks, Impulse response, Poles and Zeros, Response to excitations, Relationship to frequency response.

Block Diagrams and Signal Flow Graphs: Block diagrams, Mathematical models, Rules of block diagram, Reduction of block diagrams, Application of block diagrams, Fundamentals of Signal Flow Graphs, Definition and Construction of signal flow graph, Masons gain formula, Application of signal flow graph to networks.

Classical Time-Domain Analysis of Control Systems: Introduction, System time response – transient and steady state response, Characteristics of the graphical representation of time response, Time response of First- and Second-order systems, Sensitivity to Parameter variations – System and Pole sensitivity to parameter variations, Steady-State Errors, Types of Systems and Error Constants, Steady-state errors with inputs of special forms, Disturbance rejection.

System Stability: Stability of linear systems, Necessary conditions for stability, Stability methods, Algebraic Stability criteria - Hurwitz criterion, Routh criterion, Root locus techniques, Frequency domain analysis, Correlation between frequency response and transient response, Correlation for first- and second-order systems, Polar plots, Nyquist plots, Bode plots.

Control Systems Components: Introduction, DC motors, AC motors, Tachometers, Error Detectors, Potentiometers, LVDT, Sensors & transducers, Actuators, Electronic amplifiers.

Classical Control Design Methods: General aspects of the closed-loop control design problem, Controller circuits: Phase-Lead circuit, Phase-Lag Circuit, Phase Lag-Lead Circuit, Design with Proportional, PD, PI and PID Controllers, Concept of Ziegler-Nichols methods.

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

1. *Nagrath, I. J., and Gopal, M., Control Systems Engineering, New Age International Publishers, (2006) 4th ed.*
2. *Ogata, Katsuhiko, Modern Control Engineering, Prentice-Hall, (2010) 5th ed.*
3. *Distefano, Joseph J. , Stubberud, Allen R., Williams, Ivan J., Feedback and Control Systems, Schaum's Outlines, (1990) 2nd ed.*

Reference Books

1. *Warwick, Kevin, An Introduction to Control Systems, World Scientific Publishing Co. Ptv. Ltd, (1996) 2nd ed.*
2. *Levine, W. S., Control System Fundamentals, CRC Press, (2000) 3rd ed.*
3. *Mutambara, Arthur G. O., Design and Analysis of Control Systems, CRC Press, (1999) 2nd ed.*

UEC701 ASICs AND FPGAs

L	T	P	Cr
3	0	0	3.0

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.

Combinational Circuit Design: Components of Combinational Design - Multiplexer and Decoder, Multiplexer Based Design of Combinational Circuits, Implementation of Full Adder using Multiplexer, Decoder Implementation of Full Adder using Decoder.

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

1. *Smith, Michael.,* Application-Specific Integrated Circuits*, Addison-Wesley Professional, (2008) Ist ed.*
2. *Wolf, W.,* FPGA-based System Design*, PH/Pearson, (2004) Cheap ed.*

Reference Books

1. *Steve Kilts, Advanced FPGA Design, Wiley Inter-Science, Jhon weilly & sons, (2007) 4th ed.*

UEC801 ADVANCED SOLID STATE DEVICES

L	T	P	Cr
3	1	0	3.5

Prerequisite(s): None

Schottky Barrier Diode: S.B. diode theory, Surface states, Noise-temperature ratio. Its use as a mixer and detector.

Varacter 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.

Semiconductor Heterojunctions: Basic device model, (V-I) characteristics. Heterojunction diodes, Transistors and lasers. Power Semiconductor Devices: Power MOSFET's, SBD's of Sic Power Dissipation, Breakdown voltages: avalanche and punch through effects.

Text Books

1. *Sze, S. M., Physics of Semiconductor Devices, John Wiley & Sons, USA (2001) 2nd ed.*
2. *Baliga, B. J., Power Semiconductor Devices, PWS Publishing (2002) 2nd ed.*

Reference Books

1. *Liao, S. Y., Microwave Devices and Circuits, Pearson Education, New Delhi (1999) 4th ed.*
2. *Gupta, K.C., Microwaves, New Age International, New Delhi (1995) 3rd ed.*

UEC802 FIBER OPTIC COMMUNICATION

L	T	P	Cr
3	1	2	4.5

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 avalanvch 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

1. *Keiser, Gred, Optical Fiber Communications, Tata McGraw-Hill, (2008) 2nd ed.*
2. *Bagad, V. S., Optical Fiber Communications, Technical Publications, (2008) 3rd ed.*

Reference Books

1. *Senior, John M., and Yousif Jamro, M., Optical fiber communications: principles and practice, Prentice Hall, (2009) 2nd ed.*

2. *Bala N. Saraswathi Ravi Kumar, Comprehensive Optical Communications, Laxmi Publications (2001) 4th ed.*

UEC803 RADAR, SATELLITE AND NAVIGATIONAL AIDS

L	T	P	Cr
3	1	0	3.5

Prerequisite(s): None

Introduction to Radar: Basic Radar –The simple form of the Radar Equation – Radar Block Diagram – Radar Frequencies –Applications of Radar – The Origins of Radar

The Radar Equation: Introduction – Detection of Signals in Noise – Receiver Noise and the Signal-to-Noise Ratio –Probability Density Functions – Probabilities of Detection and False Alarm – Integration of Radar Pulses – Radar Cross Section of Targets – Radar cross Section Fluctuations – Transmitter Power – Pulse Repetition Frequency – Antenna Parameters – System losses – Other Radar Equation Considerations

MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar – Delay – Line Cancelers – Staggered Pulse Repetition Frequencies – Doppler Filter Banks – Digital MTI Processing – Moving Target Detector – Limitations to MTI Performance – MTI from a Moving Platform (MIT) – Pulse Doppler Radar – Other Doppler Radar Topics – Tracking with Radar – Monopulse Tracking – Conical Scan and Sequential Lobing – Limitations to Tracking Accuracy - Low-Angle Tracking – Tracking in Range – Other Tracking Radar Topics – Comparison of Trackers – Automatic Tracking with Surveillance Radars.

Detection of Signals in Noise: Introduction – Matched – Filter Receiver – Detection Criteria – Detectors – Automatic Detector – Integrators – Constant-False-Alarm Rate Receivers – The Radar operator – Signal Management – Propagation Radar Waves – Atmospheric Refraction – Standard propagation - Nonstandard Propagation – The Radar Antenna – Reflector Antennas – Electronically Steered Phased Array Antennas – Phase Shifters - Frequency-Scan Arrays Radar Transmitters- Introduction – Linear Beam Power Tubes – Solid State RF Power Sources – Magnetron – Crossed Field Amplifiers – Other RF Power Sources – Other aspects of Radar Transmitter. Radar Receivers – The Radar Receiver – Receiver noise Figure – Superheterodyne Receiver – Duplexers and Receiver Protectors – Radar Displays.

Radio Direction Finding: The Loop Antenna – Loop Input Circuits – An Aural Null Direction Finder – The Goniometer – Errors in Direction Finding – Adcock Direction Finders – Direction Finding at Very High Frequencies – Automatic Direction Finders – The Commutated Aerial Direction Finder – Range and Accuracy of Direction Finders Radio Ranges - The LF/MF Four course Radio Range – VHF Omni Directional Range(VOR) – VOR Receiving Equipment – Range and Accuracy of VOR – Recent Developments. Hyperbolic Systems of Navigation (Loran and Decca) - Loran-A - Loran-A Equipment - Range and precision of Standard Loran - Loran-C - The Decca Navigation System - Decca Receivers - Range and Accuracy of Decca – The Omega System, DME and TACAN - Distance Measuring Equipment - Operation of DME - TACAN - TACAN Equipment

Aids to Approach and Landing: Instrument Landing System – Ground Controlled Approach System – Microwave Landing System(MLS) Doppler Navigation – The Doppler Effect – Beam Configurations – Doppler Frequency Equations - Track Stabilization – Doppler Spectrum – Components of the Doppler Navigation System – Doppler range Equation – Accuracy of Doppler Navigation Systems. Inertial Navigation – Principles of Operation – Navigation Over the Earth – Components of an Inertial Navigation System – Earth Coordinate Mechanization - Strapped-Down Systems – Accuracy of Inertial Navigation Systems. Satellite Navigation System – The Transit System – Navstar Global Positioning System (GPS)

Text Books

1. *Skolnik, Merrill I., Introduction to Radar Systems, Tata McGraw-Hill (2003) 3rd ed.*
2. *Peebles, Peyton Z., Radar Principles, John Wiley, (2004) 2nd ed.*

Reference Books

1. *Toomay, J.C., Principles of Radar, PHI, (2004) 2nd ed.*

UEC804 WIRELESS AND MOBILE COMMUNICATION

L	T	P	Cr
3	1	2	4.5

Prerequisite(s): None

Introduction to Wireless Communication Systems: History of wireless communication, And future trends, Wireless Generations and Standards, Cellular and wireless systems, Current Wireless Systems, Cellular Telephone Systems, Wide Area Wireless Data Services, Broadband Wireless Access, Paging System, Satellite Networks, Low-Cost Low-Power Radios, Ultra wideband Radios, Examples of Wireless Communication Systems, Trends in Cellular Radio and Personal Communications.

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).

The Cellular Concept : System Design Fundamentals: Introduction. Cellular Concept and Cellular System Fundamentals, Frequency Reuse. Channel Assignment Strategies. Handoff Strategies. Interference and System Capacity. Trunking and Grade of Service. Improving Coverage & Capacity in Cellular Systems. Cell Splitting and Sectoring. Cellular system design considerations

Mobile Radio Propagation: Large-Scale Path Loss: Introduction to Radio Wave Propagation. Free Space Propagation Model. Relating Power to Electric Field. The Three Basic Propagation Mechanisms. Reflection. Ground Reflection (Two-Ray) Model. Diffraction. Scattering. Practical Link Budget Design Using Path Loss Models. Outdoor Propagation Models. Indoor Propagation Models. Signal Penetration into Buildings. Ray Tracing and Site Specific Modeling, Shadow Fading, Combined Path Loss and Shadowing, Outage Probability under Path Loss and Shadowing.

Mobile Radio Propagation: Small-Scale Fading and Multipath: Small-Scale Multipath Propagation. Impulse Response Model of a Multipath Channel. Small-Scale Multipath Measurements. Parameters of Mobile Multipath Channels. Types of Small-Scale Fading. Rayleigh and Ricean Distributions. Statistical Models for Multipath Fading Channels. Theory of Multipath Shape Factors for Small-Scale Fading Wireless Channels, Error probability and outage probability in fading channels for BPSK Modulation performance in fading and multipath channels.

Multiple Access Techniques for Wireless Communications: Introduction. Frequency Division Multiple Access (FDMA). Time Division Multiple Access (TDMA). Spread Spectrum Multiple Access. Space Division Multiple Access (SDMA), MIMO, OFDMA, Capacity of Cellular Systems.

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

1. R*appaport, T.S., Wireless Communication-Principles and practice, Pearson, (2000) 2nd edition*
2. *Haykin S & Moher M., Modern wireless communication, Pearson, (2005) 3rd edition.*

Reference Books

1. *Lee, Willium C. Y., Mobile communication Design and fundamentals, (1999) 4th edition.*
2. *Pandya, R., Mobile and personal communication system, PHI (2002) 5th edition.*

UEC611 AUDIO AND SPEECH PROCESSING

L	T	P	Cr
3	1	2	4.5

Prerequisite(s): None

Introduction: Review of digital signal and systems, Transform representation of signal and systems, Sampling Theorem, Digital filters and filter banks.

Digital Models for Speech Signals: Speech production and acoustic tube modeling, Acoustic phonetics, Anatomy and physiology of the vocal tract and ear, Hearing and perception.

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 Vocoders: 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

1. *Borden, G., and Harris, K., Speech Science Primer,Williams and Wilkins (2006) 2nd ed.*
2. *Furui, S., Digital Speech Processing, Synthesis and Recognition, CRC (2001) 4th ed.*

Reference Books

1. *Deller, J., Proakis, J. and Hansen, J., Discrete-Time Processing of Speech Signals, IEEE (1993) 2nd ed.*
2. *Rabiner, L., and Schafer, R., Digital Processing of Speech Signals. Signal Processing, Prentice-Hall (1978) 3rd ed.*
3. *Owens, F. J, Signal Processing of Speech, McGraw-Hill (1993) 4th ed.*
4. *Parsons, T., Voice and Speech Processing: Communications and Signal Processing, McGraw-Hill (1986) 2nd ed.*

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.

Synchronous Sequential Logic: Flip-flops, Triggering of flip-flops, Analysis of clocked sequential circuits, State reduction and assignment, Flip-flop excitation tables, Design procedure, Design of counters,

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

1. *Roth, Jr., Charles H and John, Lizy K., Digital Systems Design using VHDL, Thomson Learning, (2006) 3rd ed.*
2. *Kohavi, Zvi, Switching and Finite Automata Theory, McGraw Hill, (1978) 2nd ed.*

Reference Books

1. *Bhasker, Jayaram, VHDL Primer, Pearson Education, (1999) 3rd ed.*
2. *Ashenden, Peter J., Designer's guide to VHDL, Morgan Kaufmann Publishers,(2008) 3rd ed.*
3. *Mano , M. M., Digital Design, PHI, (2002) 2nd ed.*

UEC613 LINEAR INTEGRATED CIRCUITS ANALYSIS

L	T	P	Cr
3	1	2	4.5

Prerequisite(s): None

Introduction to Operational Amplifiers: The Ideal Op-Amp, Block diagram Representation of Op-Amp, Voltage Transfer Curve of Op-Amp, Integrated Circuit: Package Types, Pin Identification and Temperature- Ranges, Interpretation of Data sheets and Characteristics of an Op-Amp, Inverting and Non-Inverting Configuration, Ideal Open-Loop and Closed-Loop Operation of Op-Amp, Block diagram Representation of Feedback Configurations, Voltage-Series Feedback Amplifier, Voltage-Shunt Feedback Amplifier, Differential Amplifiers with One & Two Op-Amps.

Frequency Response of an Op-Amp: Introduction, Frequency Response, Compensating Networks, Frequency Response of Internally Compensated Op-Amp, Frequency response of Non-compensated Op-Amp, Closed-Loop Frequency Response, Circuit Stability, Slew Rate.

General Linear Applications: DC & AC Amplifiers, Peaking Amplifier, Summing, Scaling and Averaging amplifier, Instrumentation Amplifier, Voltage-to-Current Converter, Current to-Voltage Converter, The Integrator, The Differentiator, Log and Antilog Amplifier, Peak Detector, Precision Rectifiers, Comparator, Zero Crossing Detector, Schmitt Trigger, Sample and Hold Circuit, Clippers and Clampers, A/D and D/A Converters.

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

1. *Gayakwad, Ramakant A., OP-AMP and Linear IC's, Prentice Hall (1999) 2nd ed.*
2. *Taub and Schilling , Digital Integrated Electronics, McGraw Hill (1994) 4th ed.*

Reference Books

1. *Millman J. and Halkias, Integrated Electronics, McGraw Hill (2000) 4th ed.*
2. *Caughlier and Driscoll, Op-Amp and Linear IC, Prentice Hall (2001) 2nd ed.*

UEC614 TELECOMMUNICATION ENGINEERING

L	T	P	Cr
3	1	2	4.5

Prerequisite(s): None

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.

Digital Exchanges and Control: EPABX architecture, Network synchronization, Digital subscriber lines (DSL), GDMT and G.Lit Digital subscriber lines, Video on demand (VoD), ADSL, Traditional Cable Networks, HFC Networks, Sharing, CM & CMTS and DOCSIS. Signaling: customer line signaling – outband signaling – inband signaling – PCM signaling – inter register signaling – common channel signaling principles – CCITT signaling system No:7 – digital customer line signaling, cross-talks and interference in telecomm networks, SDH & SONET: Devices, Frame, Frame Transmission, Synchronous Transport Signals, STS I, Virtual Tributaries and Higher rate of service. Introduction to ATM switching – Strict sense non block switch – self routing switches – Bense network – ATM routers – Design of typical switches, ATM traffic & congestion control, Signaling, Routing and addressing, ISDN architecture, ISDN interfaces, Functional grouping, Reference points, protocol architecture, Signaling, Numbering, Addressing, BISDN. Fax system: Basic facsimile system, Facsimile applications working of FAX machines, Recording media, FAX reproduction technique. Public switched data networks, Connection oriented & connection less service, Data compression-Network security-cryptography.

Traffic Engineering: Grade of Service and Blocking Probability – Telephone Networks, Subscriber Loops, Switching Hierarchy and Routing, Network traffic load and parameters – grade of service and blocking probability – incoming traffic and service time characterization – blocking models and loss estimates – delay systems, Modeling and performance analysis in networks. DTE/DCEs (EIA-232, 449, X.21), Modems, 56K Modems, Cable Modems), Characteristics of Queuing Process, Markov chain. Markov Chain Queuing Models: M/M/1, birth-death process, Time-dependent state probability, Balance equation, Network of exponential servers, Generating function, Phase-dependent arrival and service, Steady state solution, A/B/C/D/E. Advance Markovian Models: bulk arrivals and services, Erlang arrivals and services, Priority queues. M/G/1 and G/M/1: M/G/1, Occupancy distribution, Renewal theory, Waiting time and busy period, preemptive-resume LCFS, head-of-the-line priority, Embedded Markov chain. Queueing Networks: Series Queues, Jackson Networks, Cyclic Queues.

Text Books

1. *Viswanathan T., Telecommunication Switching Systems and Networks, Prentice Hall of India (2006) 2nd ed.*
2. *Betsekos D and Gallager R., Data Networks, Prentice Hall (1992) 2nd ed.*

Reference Books

1. *Tanenbaum A. S., Computer Networks, PHI, (2003) 3rd ed*
2. *Schwartz M., Wesley Addision, Telecommunication Networks - Protocols, Modeling and Analysis, Massacheusetts, (1987) 3rd ed.*
3. *Flood J. E., Telecommunications Switching Traffic and Networks, Pearson, (2002) 2nd ed.*
4. *Freeman R. L., Telecommunication System Engineering, John Wiley New York, 1998 3rd ed.*
5. *Tomasi Wayne, Advanced Electronic Communications Systems, Pearson Ed., (2008) 5th ed.*
6. *Bellamy J., Digital Telephony, John Wiley and Sons New York, (2000) 4th ed*

UEC621 CMOS CIRCUIT DESIGN

L	T	P	Cr
3	1	2	4.5

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.

NMOS & CMOS Process technology: Evolution of ICs. Masking sequence of NMOS and CMOS Structures. Latch up in CMOS, Electrical Design Rules, Stick Diagram, Layout Design.

Circuit Characterization: Resistive Load & Active Load MOS Inverters, NMOS Inverters, CMOS Inverters : Static Characteristics, Switching Characteristics, Interconnect Parasitics, Propagation Delay, Static and Dynamic Power Dissipation, Noise Margin, Logic Threshold Voltage, Logical effort, Driving large loads.

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.

Sequential Circuits: Behavior of Bistable elements, SR Latch Circuit, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-triggered Flip-flop.

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:

1. *Kang ,Sung-Mo (Steve) & Leblebici, Yusuf., CMOS Digital Integrated Circuits Analysis & Design, McGraw Hill, (1999) 2nd ed.*
2. *Uyemura, J. P., CMOS Logic Circuit Design, Kluwer Academic Publishers, (2002) 2nd ed.*

Reference Books:

1. *Weste N., & Eshraghian, K., Priciples of CMOS VLSI Design, Addison Wesley, (1998) 2nd ed.*
2. *Jan Rabaey, A. Chandrakasan & Nikolic, B., Digital Integrated Circuits – A Design Perspective, Pearson, (2003) 2nd ed.*
3. *Weste ,Neil & Harris, David.,* CMOS VLSI Design: A Circuits & Systems Perspective, *Addison Wesley*, (2004) *3rd ed.*
4. *Pucknell D. A., & Eshraghian, K., Basic VLSI Design, Prentice Hall of India,* (2007) *3rd ed.*

UEC622 DSP PROCESSORS

L	T	P	Cr
3	1	2	4.5

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

1. *Lapsley, P., Bier, J., Shoham,A., Lee, E.A., DSP Processor Fundamentals, Architectures and Features, IEEE Press Series on signal Processing (1990) 2nd ed.*
2. *Venkataramani, B., and Bhaskar, M., Digital Signal Processers, Architecture, Programming and Applications, Tata McGraw-Hill (2000) 4th ed.*

Reference Books

1. *Ifeachor, E.C., and Jervis, B.W., Digital Signal Processing, A practical approach, Addison Wesley(1995) 4th ed.*
2. *Padmanabhan K., Ananthi S. and Vijayarajeswaran R., A practical approach to digital signal processing, New Age International Pvt. Ltd (2001) 3rd ed.*

3. *Babsi , J., and Engelwood Cliffs: Digital Signal Processing Application using the ADSP-2100 family, PHI(1994) 4th ed.*
4. *Chassaing, R., Digital Signal Processing with C and the TMS320C30, Wiley (2002) 2nd ed.*

UEC623 FPGA BASED SYSTEM DESIGN

L	T	P	Cr
3	1	2	4.5

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.

FPGA based system Implementation: Combinational Circuits, FPGA Sequential Circuits, Timing Issues in FPGA Synchronous Circuits, Clock skew, clocking styles, Self-timed circuit design, Case study of Kitchen timer chip, Introduction to Verilog/VHDL and FPGA Design flow with using Verilog/VHDL, FPGA Arithmetic Circuits, FPGAs in DSP Applications, FPGA Implementation of Direct Digital Frequency Synthesizer, FPGA Microprocessor design.

Design Case Study: Design of SDRAM Controller, Design Case Study: Design of Halftone Pixel Converter, FPGA High-level Design Techniques, Programming FPGAs in Electronic Systems, Dynamically Reconfigurable Systems, Latest Trends in Programmable ASIC and System Design.

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

1. *Wolf, Wayne., FPGA-Based System Design, Prentice Hall, (2004) 2nd ed.*
2. *Clive Max Maxfield, Design warrior's guide to FPGA, Elsevier, (2004) 3rd ed.*

Reference Books

1. *Steve Kilts, Advanced FPGA Design, Wiley Inter-Science, Jhon weilly & sons, (2007) 4th ed.*

Xilinx User Manuals and Application Notes

UEC624 SOFT COMPUTING TECHNIQUES

L	T	P	Cr
3	1	2	4.5

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.

Fuzzy Set Theory: Introduction Fuzzy Sets, Basic Definition and Terminology, Fuzziness vs probability, Crisp logic vs fuzzy logic, Set-theoretic Operations, Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy Modeling, De-Fuzzification, De fuzzy controllers, Type-2 Fuzzy Logic Controllers, Multi-layer and other advanced Fuzzy Logic Models, Applications of Fuzzy Logic.

Optimization: Derivative-based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing, Random Search, Downhill Simplex Search.

Genetic Algorithms: Introduction and concept as a process modeling tool, Genetic Algorithms and its Operators, Coding, reproduction, Cross-over and mutation Scaling, Fitness, Binary Coded Genetic Algorithm and its use in Engineering Process Modeling, Unimodal vs Multimodal problems in GA and their significance, Applications.

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

Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN, Coactive Neuro Fuzzy Modeling, Framework Neuron Functions for Adaptive Networks, Neuro Fuzzy Spectrum.

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

1. *Jang, J.S.R., Sun, C.T., and Mizutani, E., Neuro-Fuzzy and Soft Computing, Pearson Education (2004) 2nd ed.*
2. *Eberhart, R., Simpson, P., and Dobbins, R., Computational Intelligence - PC Tools, AP Professional (1996) 3rd ed.*

Reference Books

1. *Ross, Timothy J., Fuzzy Logic with Engineering Applications, McGraw-Hill (1997) 2nd ed.*
2. *Goldberg, Davis E., Genetic Algorithms: Search, Optimization and Machine Learning, Wesley Addison (1989) 3rd ed.*
3. *Rajasekaran, S., and Pai, G.A.V., Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI (2003) 4th ed.*

UEC741 ARTIFICIAL INTELLEGENCE

L	T	P	Cr
3	1	0	3.5

Prerequisite(s): None

Introduction: Intelligent Agents – Agents and environments - Good behavior – The nature of environments – structure of agents - Problem Solving - problem solving agents – example problems – searching for solutions – uniformed search strategies - avoiding repeated states – searching with partial information.

Searching Techniques: Informed search and exploration – Informed search strategies – heuristic function – local search algorithms and optimistic problems – local search in continuous spaces – online search agents and unknown environments - Constraint satisfaction problems (CSP) – Backtracking search and Local search for CSP – Structure of problems - Adversarial Search – Games – Optimal decisions in games – Alpha – Beta Pruning – imperfect real-time decision – games that include an element of chance.

Knowledge Representation: First order logic – representation revisited – Syntax and semantics for first order logic – Using first order logic – Knowledge engineering in first order logic - Inference in First order logic – prepositional versus first order logic – unification and lifting – forward chaining – backward chaining – Resolution – Knowledge representation – Ontological Engineering – Categories and objects – Actions – Simulation and events – Mental events and mental objects

Prolog: Basic constructs, Answer extraction

Bayesian Reasoning: Bayesian networks, Dynamic Bayesian networks

Planning: State-space search, Planning graphs

Learning: Learning from observations – forms of learning – Inductive learning – Learning decision trees – Ensemble learning - Knowledge in learning – Logical formulation of learning – Explanation based learning – Learning using relevant information – Inductive logic programming – Statistical learning methods – Learning with complete data – Learning with hidden variable – EM algorithm – Instance based learning – Neural networks – Reinforcement learning – Passive reinforcement learning – Active reinforcement learning – Generalization in reinforcement learning.

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

Applications: Communication – Communication as action – Formal grammar for a fragment of English – Syntactic analysis – Augmented grammars – Semantic interpretation – Ambiguity and disambiguation – Discourse understanding – Grammar induction – Probabilistic language processing – Probabilistic language models – Information retrieval – Information Extraction – Machine translation

Text Books

1. *Stuart Russell, Peter Norvig, Artificial Intelligence – A Modern Approach, , Pearson Education / Prentice Hall of India, (2004) 2nd Ed.*
2. *Elaine Rich and Kevin Knight, Artificial Intelligence, Tata McGraw-Hill, (2003) 2nd Ed.*

Reference Books

1. *Nils J. Nilsson, Artificial Intelligence, A new Synthesis, Harcourt Asia Pvt Ltd., (2000) 3rd ed.*
2. *George F. Luger, Artificial Intelligence-Structure and Strategies for Complex Problem Solving, Pearson Education/PHI, (2002) 2nd ed.*

UEC742 MEMS

L	T	P	Cr
3	1	0	3.5

Prerequisite(s): None

Introduction: History of MicroElectroMechanical Systems (MEMS), Market for MEMS, Basics of microtechnology, Lithography and etching techniques, Principles of bulk and surfacemicromachining: subtractive processes, Additive processes (evaporation, Sputtering, Epitaxial growth).

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

1. *Gregory, T. A. Kovacs Micromachined Transducers Sourcebook, WCBMcGraw-Hill, (1998) 2nd ed.*
2. *Nadim Maluf, An introduction to Microelectromechanical system design, ArtechHouse, (2000) 3rd ed.*
3. *Victor M. Bright, Editor, Selected papers on Optical MEMS, SPIE Milestone Series, Volume MS 153, SPIE Press, (1999) 2nd ed.*

Reference Books

1. *Mohamed Gad-el-Hak, The MEMS Handbook, CRC Press, Baco Raton, (2001) 3rd ed.*
2. *Marc Madou, Fundamentals of Microfabrication, CRC Press, New York, (1997) 2nd ed.*

UEC743 RELIABILITY ENGINEERING

L	T	P	Cr
3	1	0	3.5

Prerequisite(s): None

Basic Principles: Elements of probability theory, Elements of statistical theory, Some general stochastic processes, Statistical failure models, System reliability, Reliability improvement, Fault tree analysis, Reliability physics models, Failures of systems and its modes, Measures of reliability, Reliability function, Hazard rate MTBF and their inter-relations, Reliability data and analysis: Data sources, Data collection, Use of reliability data, Reliability analysis, Performance parameters, Calculation of failure rate, Application of Weibull distribution, System reliability and modeling: series systems, Parallel system, Series parallel systems, Time dependence, Reliability determination, Stand-by systems r out of n configurations, Methods of tie set and cut-sets, Reliability evaluation, Simulation and Reliability prediction. Monte Carlo method, Maintainability and availability: maintainability and its equation, Factors affecting maintainability, Measures of maintainability, Mean down time, Availability intrinsic availability equipment availability & mission availability, Replacement processes and policies.

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-tucjer 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.

Reliability of Electronic Systems: Detailed part consideration: component reliability, Derating, Failure analysis of passive components and integrated circuits, Accelerated testing, Electrostatic discharge, VLSI reliability issues, Circuit design and analysis: Analog circuit reliability, Circuit tolerance analysis methods, Redundancy, Equipment design: Electromagnetic compatibility, Electrostatic discharge, Vibration, Environmental considerations, Environmental stress screening cad/cam electronic components, Circuits and equipments for reliability manufacturing issues.

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

1. *Fuqua Norman B., Reliability Engineering for Electronic Design, M. Dekker, (1987) 2nd ed.*
2. *Birolini Alessandro, Reliability Engineering, Theory and Practice, Springer, (2007) 4th ed.*

Reference Books

1. *Sreenath S. L., Reliability Engineering, Eas West Press, New Delhi, (1991) 3rd ed.*
2. *Govil A. K., Reliability Engineering, Tata McGraw-Hill, (1983) 2nd ed.*
3. *Banga and Sharma, Industrial Engineering & Management, Khanna Publisher, (1992) 2nd ed.*

UEC851 VLSI DIGITAL SIGNAL PROCESSING

L	T	P	Cr
3	1	0	3.5

Prerequisite(s): None

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.

Algorithmic Transformations: Retiming, Properties of retiming, retiming techniques, Cut-set retiming and pipelining, Retiming for clock period minimization, Retiming for register minimization, Unfolding, Properties of unfolding, Sample period reduction, Parallel processing, Bit-serial, Digit-serial and Parallel Architectures of DSP Systems, Folding, Folding order, Folding Factor, Retiming for folding, Register Minimization technique, Forward Backward Register Allocation technique.

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

Algorithm Strength Reduction: Introduction, Parallel FIR filters, Fast FIR filters Algorithms, Discrete Cosine Transform and Inverse Discrete Cosine Transform, Pipelined and Parallel Recursive and Adaptive Filters, Parallel processing in IIR Filters, Combining Pipelining and Parallelism.

Scaling and Round-off Noise: Introduction, State variable description of Digital Systems, Scaling and Round-off Noise Computation.

Text Books

1. *Parhi, K.K., VLSI Digital Signal Processing Systems: Design and Implementation, John Wiley (2007) 2nd ed.*
2. *Wanhammar, L., DSP Integrated Circuits, Academic Press (1999) 4th ed.*

Reference Books

1. *Oppenheim, A.V. and Schafer, R.W., Discrete-Time Signal Processing, Prentice Hall (2009) 2nd ed.*
2. *Mitra, S.K., Digital Signal Processing. A Computer Based Approach, McGraw Hill (2007)3rd ed.*

UEC852 WIRELESS SENSOR NETWORKS

L	T	P	Cr
3	1	0	3.5

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

1. *Pahlavan, Kaveh., Krishnamoorthy, Prashant., Principles of Wireless Networks, - A united approach - Pearson Education, (2002) 2nd ed.*
2. *Wang, X., and Poor, H.V., Wireless Communication Systems, Pearson education, (2004) 3rd ed.*

Reference Books

1. *Schiller, Jochen., Mobile Communications, Person Education – 2003, 2nd ed.*
2. *Mallick, M., Mobile and Wireless design essentials, Wiley Publishing Inc. (2003) 4th ed.*
3. *Nicopolitidis, P., Obaidat, M.S., Papadimitria, G.I., Pomportsis, A. S., Wireless Networks, John Wiley & Sons, (2003) 2nd ed.*

UEC853 WIRELESS ADHOC NETWORKS

L	T	P	Cr
3	1	0	3.5

Prerequisite(s): None

Fundamentals: Introduction – Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio Propagation Mechanisms – Characteristics of the Wireless Channel – IEEE 802.11a–b Standard – Origin of Ad hoc Packet Radio Networks – Technical Challenges – Architecture of PRNETs – Components of Packet Radios – Ad hoc Wireless Networks – What is an Ad Hoc Network? Heterogeneity in Mobile Devices – Wireless Sensor Networks – Traffic Profiles – Types of Ad hoc Mobile Communications – Types of Mobile Host Movements – Challenges Facing Ad hoc Mobile Networks – Ad hoc wireless Internet.

AD HOC Routing Protocols: Introduction – Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks – Classifications of Routing Protocols – Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV) – Wireless Routing Protocol (WRP) – Cluster Switch Gateway Routing (CSGR) – Source–Initiated On–Demand Approaches – Ad hoc On–Demand Distance Vector Routing (AODV) – Dynamic Source Routing (DSR) –Temporally Ordered Routing Algorithm (TORA) – Signal Stability Routing (SSR) –Location–Aided Routing (LAR) – Power–Aware Routing (PAR) – Zone Routing Protocol (ZRP).

Multicast Routing In Ad hoc Networks: Introduction – Issues in Designing a Multicast Routing Protocol – Operation of Multicast Routing Protocols – An Architecture Reference Model for Multicast Routing Protocols – Classifications of Multicast Routing Protocols – Tree–Based Multicast Routing Protocols– Mesh–Based Multicast Routing Protocols – Summary of Tree and Mesh based Protocols – Energy–Efficient Multicasting – Multicasting with Quality of Service Guarantees – Application – Dependent Multicast Routing – Comparisons of Multicast Routing Protocols.

Transport Layer – Security Protocols: Introduction – Issues in Designing a Transport Layer Protocol for Ad hoc Wireless Networks – Design Goals of a Transport Layer Protocol for Ad hoc Wireless Networks – Classification of Transport Layer Solutions – TCP over Ad hoc Wireless Networks – Other Transport Layer Protocols for Ad hoc Wireless Networks – Security in Ad Hoc Wireless Networks – Network Security Requirements – Issues and Challenges in Security Provisioning – Network Security Attacks – Key Management – Secure Routing in Ad hoc Wireless Networks.

QoS And Energy Management: Introduction – Issues and Challenges in Providing QoS in Ad hoc Wireless Networks –Classifications of QoS Solutions – MAC Layer Solutions – Network Layer Solutions – QoS Frameworks for Ad hoc Wireless Networks Energy Management in Ad hoc Wireless Networks – Introduction – Need for Energy Management in Ad hoc Wireless Networks – Classification of Energy Management Schemes – Battery Management Schemes – Transmission Power Management Schemes – System Power Management Schemes.

Text Books

1. *Siva Ram Murthy, C. and Manoj,B. S., Adhoc Wireless Networks Architectures and Protocols, Prentice Hall, PTR, (2004) 2nd ed.*
2. *Perkins, Charles E., Ad hoc Networking, Addison Wesley, (2000) 3rd ed.*

Reference Books

1. *Toh, C. K., Ad hoc Mobile Wireless Networks Protocols and Systems, Prentice Hall, PTR, (2001) 3rd ed.*