**IV Year – I SEMESTER**

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## VLSI DESIGN

**OBJECTIVES**

The student will be introduced to

- Use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnects.
- Learn the various fabrication steps of IC and come across basic electrical properties of MOSFET.
- Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect and to verify the functionality, timing, power and parasitic effects.
- The concepts and techniques of modern integrated circuit design and testing (CMOS VLSI).
- Design static CMOS combinational and sequential logic at the transistor level, including mask layout.

**Unit-I:**

**Introduction :** Introduction to IC Technology, MOS and related VLSI Technology, Basic MOS Transistors, Enhancement and Depletion modes of transistor action, IC production process, MOS and CMOS Fabrication processes, BiCMOS Technology, Comparison between CMOS and Bipolar technologies.

**Basic Electrical Properties Of MOS and Bi-CMOS Circuits:** $I_{ds}$ versus $V_{ds}$ Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans, Output Conductance and Figure of Merit. The Pass transistor, NMOS Inverter, Pull-up to Pull-down Ratio for NMOS inverter driven by another NMOS inverter. Alternative forms of pull-up, The CMOS Inverter, MOS transistor circuit model, Bi-CMOS Inverter, Latch-up in CMOS circuits and BiCMOS Latch-up Susceptibility.

**Unit-II:**

**MOS and Bi-CMOS Circuit Design Processes:** MOS Layers, Stick Diagrams, Design Rules and Layout, General observations on the Design

rules, 2µm Double Metal, Double Poly, CMOS/BiCMOS rules, 1.2µm Double Metal, Double Poly CMOS rules, Layout Diagrams of NAND and NOR gates and CMOS inverter, Symbolic Diagrams-Translation to Mask Form.

**Unit-III:**

**Basic Circuit Concepts:** Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, The Delay Unit, Inverter Delays, Propagation Delays, Wiring Capacitances, Fan-in and fan-out characteristics, Choice of layers, Transistor switches, Realization of gates using NMOS, PMOS and CMOS technologies.

**Scaling Of MOS Circuits:** Scaling models, Scaling factors for device parameters, Limits due to sub threshold currents, current density limits on logic levels and supply voltage due to noise.

**Unit-IV:**

**Subsystem Design:** Architectural issues, switch logic, Gate logic, examples of structured design, clocked sequential circuits, system considerations, general considerations of subsystem design processes, an illustration of design processes.

**Unit-V:**

**VlSI Design Issues:** VLSI Design issues and design trends, design process, design for testability, technology options, power calculations, package selection, clock mechanisms, mixed signal design, ASIC design flow, FPGA design flow, introduction to SoC design.

**Unit-VI:**

**FPGA Design:** Basic FPGA architecture, , FPGA configuration, configuration modes, FPGA design process- FPGA design flow, FPGA families, FPGA design examples-stack, queue and shift register implementation using VHDL, step-by-step approach of FPGA design process on Xilinx environment.

**Text Books:**

1. Essentials of VLSI Circuits and Systems By Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited,2005 Edition.
2. VLSI Design-Black Book By Dr. K.V.K.K. Prasad, Kattula Shyamala, Kogent Learning Solutions Inc.2012 Edition.

**References:**

1. VLSI Design By A.Albert Raj & T.Latha,PHI Learning Private Limited,2010.
2. VLSI Design-A.Shanthi and A.Kavita, New Age International Private Limited, 2006 First Edition.

**OUTCOMES**

After going through this course the student will be able to

- Apply the Concept of design rules during the layout of a circuit.
- Model and simulate digital VLSI systems using hardware design language.
- Synthesize digital VLSI systems from register-transfer or higher level descriptions
- Understand current trends in semiconductor technology, and how it impacts scaling and performance.

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**IV Year – I SEMESTER**

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## COMPUTER NETWORKS

**Objectives**

The aim of this course is to introduce key concepts and principles of computer networks. The course will use a top-down approach to study the Internet and its protocol stack. Architecture, protocol, application-examples will include email, web and media-streaming. We will cover communications services (e.g., TCP/IP) required to support such network applications. The implementation and deployment of communications services in practical networks: including wired and wireless LAN environments, will be followed by a discussion of issues of network-security and network-management. Internet's architecture and protocols will be used as the primary examples to illustrate the fundamental principles of computer networking.

**UNIT I**
**INTRODUCTION**

OSI, TCP/IP and other networks models, Examples of Networks: Novell Networks, Arpanet, Internet, Network Topologies WAN, LAN, MAN.

**UNIT II**
**PHYSICAL LAYER**

Transmission media copper, twisted pair wireless, switching and encoding asynchronous communications; Narrow band, broad band ISDN and ATM.

**UNIT III**
**DATA LINK LAYER**

Design issues, framing, error detection and correction, CRC, Elementary Protocol-stop and wait, Sliding Window. Medium Access Sub Layer: ALOHA, MAC addresses, Carrier sense multiple access, IEEE 802.X Standard Ethernet, wireless LANS, Bridges.

**UNIT IV**
**NETWORK LAYER**

Virtual circuit and Datagram subnets-Routing algorithm shortest path routing, Flooding, Hierarchical routing, Broad cast, Multi cast, distance vector routing. **DYNAMIC ROUTING:** Broadcast routing. Rotary for mobility, Congestion, Control Algorithms – General Principles of Congestion prevention policies. Internetworking: The Network layer in the internet and in the ATM Networks.

**UNIT V**
**TRANSPORT LAYER**
Transport Services, Connection management, TCP and UDP protocols; ATM AAL Layer Protocol.

**UNIT VI**
**APPLICATION LAYER**

Network Security, Domain name system, SNMP, Electronic Mail; the World WEB, Multi Media.

**TEXT BOOKS**

1. Computer Networks — Andrew S Tanenbaum, 4th Edition. Pearson Education/PHI.
2. Data Communications and Networking – Behrouz A. Forouzan.Third Edition TMH.

**REFERENCES**

1. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition,Pearson Education.
2. Understanding communications and Networks, 3rd Edition, W.A. Shay, Thomson.

***Outcomes:***
The student will be able to

Analyze a communication system by separating out the different functions provided by the network; and some example networks.

Understand various network topologies required for communication

Understand that there are fundamental limits to any communications system;

Understand the general principles behind addressing, routing, reliable transmission and other stateful protocols as well as specific examples of each;
Have an informed view of both the internal workings of the Internet and of a number of common Internet applications and protocols.

**IV Year – I SEMESTER**

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## DIGITAL IMAGE PROCESSING

**OBJECTIVES**

The student will

- Learn the fundamental concepts and applications of Digital Image Processing.
- Learn the concepts of and how to perform Intensity transformations and spatial filtering.
- Understand the relationship between Filtering in spatial and frequency domains,
- Understand the concepts of and how to perform Image restoration and reconstruction.
- Understand the concepts of different color models and Color image processing.
- Learn the concepts of Wavelets and multi-resolution processing, Image compression and Watermarking, Morphological image processing, Image segmentation, Representation and description.

**UNIT-1**

**Introduction:** Origins of digital image processing, uses digital image processing, fundamental steps in digital image processing, components of an image processing system, digital image fundamentals, Elements of visual perception, light and electromagnetic spectrum, imaging sensing and acquisition, image sampling and quantization. Some basic relationships between pixels, an introduction to the mathematical tools used in digital image processing.

**Image Transforms:** Need for image transforms, Spatial Frequencies in image processing, introduction to Fourier transform, discrete Fourier transform, fast Fourier transform and its algorithm, properties of Fourier transform. Discrete sine transforms. Walsh Transform. Hadamard transform, Haar Transform. Slant transforms, SVD and KL Transforms or Hotelling Transform

**UNIT-2**

**Intensity Transformations and Spatial Filtering:** Background, Some basic intensity transformation functions, histogram processing, fundamentals of

spatial filtering, smoothing spatial filters, sharpening spatial filters, Combining spatial enhancement methods, using fuzzy techniques for intensity transformations and spatial filtering.

**Filtering in the frequency domain:** Preliminary concepts, Sampling and the Fourier transform of sampled functions, the discrete Fourier transform (DFT) of one variable, Extension to functions of two variables, some properties of the 2-D Discrete Fourier transform. The Basic of filtering in the frequency domain, image smoothing using frequency domain filters, Selective filtering, Implementation.

**UNIT-3**

**Image restoration and Reconstruction:** A model of the image degradation / Restoration process, Noise models, restoration in the presence of noise only-Spatial Filtering, Periodic Noise Reduction by frequency domain filtering, Linear, Position –Invariant Degradations, Estimation the degradation function, Inverse filtering, Minimum mean square error(Wiener) filtering ,constrained least squares filtering ,geometric mean filtering ,image reconstruction from projections.

**Unit-4**

**Color image processing:** color fundamentals, color models, pseudo color image processing, basic of full color image processing, color transformations, smoothing and sharpening. Image segmentation based on color, noise in color images, color image compression.

**Unit-5**

**Wavelets and Multi-resolution Processing:** image pyramids, sub band coding & Haar transforms multi resolution expressions, wavelet transforms in one dimensions. The fast wavelets transform, wavelet transforms in two dimensions, wavelet packets.

**Image compression:** Fundamentals, various compression methods-coding techniques, digital image water marking.

**Unit-6**

**Morphological image processing:** preliminaries Erosion and dilation, opening and closing, the Hit-or-miss transformation, some Basic Morphological algorithms, grey –scale morphology

**Image segmentation:** Fundamentals, point, line, edge detection thresholding, region –based segmentation, segmentation using Morphological watersheds, the use of motion in segmentation**.**

**TEXT BOOKS :**

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3rd edition, Prentice Hall, 2008.
2. R. C. Gonzalez, R. E. Woods and Steven L. Eddins , Digital Image Processing Using MATLAB , 2rd edition, Prentice Hall, 2009.
3. Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 9th Edition, Indian Reprint, 2002.
4. Jayaraman, S. Esakkirajan, and T. Veerakumar, Digital Image Processing, Tata McGraw-Hill Education, 2011.

**OUTCOMES**

After going through this course the student will be able to

- Perform different transforms on image useful for image processing applications
- Perform spatial and frequency domain filtering on image and can implement all smoothing and sharpening operations on images
- Perform image restoration operations/techniques on images
- Operate effectively on color images and different color conversions on images and can code images to achieve good compression
- Do wavelet based image processing and image compression using wavelets
- Perform all morphological operations on images and can be able to do image segmentation also.
- Develop simple algorithms for image processing and use the various techniques involved in Bio Medical applications, etc.

**IV Year – I SEMESTER**

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## COMPUTER ARCHITECTURE AND ORGANIZATION

**Objectives**

The student will

- Understand the fundamentals of different instruction set architectures and their relationship to the CPU design.
- Understand the principles and the implementation of computer arithmetic and ALU.
- Understand the memory system, I/O organization
- Understand the operation of modern CPUs including interfacing, pipelining, memory systems and busses.
- Understand the principles of operation of multiprocessor systems.

**UNIT-I**

**BASIC STRUCTURE OF COMPUTERS:** Computer Types, Functional units, Basic operational concepts, Bus structures, Software, Performance, multiprocessors and multi computers. Data types, Complements, Data Representation. Fixed Point Representation. Floating – Point Representation. Error Detection codes.

**COMPUTER ARITHMETIC:** Addition and subtraction, multiplication Algorithms, Division Algorithms, Floating point Arithmetic operations. Decimal Arithmetic unit, Decimal Arithmetic operations.

**UNIT-II**

**REGISTER TRANSFER LANGUAGE AND MICRO-OPERATIONS:** Register Transfer language. Register Transfer, Bus and memory transfer, Arithmetic Micro-operations, logic micro operations, shift micro-operations, Arithmetic logic shift unit. Instruction codes. Computer Registers Computer instructions –Instruction cycle. Memory Reference Instructions. Input Onput and Interrupt. **CENTRAL PROCESSING UNIT** - Stack organization. Instruction formats. Addressing modes. DATA Transfer and manipulation. Program control. Reduced Instruction set computer

**UNIT-III**

**MICRO PROGRAMMED CONTROL:** Control memory, Address sequencing, micro program example, Design of control unit-Hard wired control. Micro programmed control

**UNIT-IV**

**THE MEMORY SYSTEM:** Memory Hierarchy, Main memory, Auxiliary memory, Associative memory, Cache memory, Virtual memory, Memory management hardware

**UNIT-V**

**INPUT-OUTPUT ORGANIZATION :** Peripheral Devices, Input-Output Interface, Asynchronous data transfer Modes of Transfer, Priority Interrupt, Direct memory Access, Input –Output Processor (IOP), Serial communication;

**UNIT-VI**

**PIPELINE AND VECTOR PROCESSING:** Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline Vector Processing, Array Processors. **Multi processors:** Characteristics of Multiprocessors, Interconnection Structures, Interprocessor Arbitration. Interprocessor Communication and Synchronization, Cache Coherence.

**TEXT BOOKS:**

1. Computer System Architecture – M.Moris Mano, IIIrd Edition, PHI / Pearson, 2006.
2. Computer Organization – Car Hamacher, ZvonksVranesic, SafwatZaky, V Edition, McGraw Hill, 2002.

**REFERENCES:**

1. Computer Organization and Architecture – William Stallings Seventh Edition, PHI/Pearson, 2006.
2. Computer Architecture and Organization – John P. Hayes, Mc Graw Hill International editions, 1998.

**Objectives :**

- Understand the fundamentals of different instruction set architectures and their relationship to the CPU design.
- Understand the principles and the implementation of computer arithmetic and ALU.
- Understand the memory system, I/O organization
- Understand the operation of modern CPUs including interfacing, pipelining, memory systems and busses.
- Understand the principles of operation of multiprocessor systems.
- Demonstrate the relationship between the software and the hardware and focuses on the foundational concepts that are the basis for current computer design.

**IV Year – I SEMESTER**

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**Elective I**

# ELECTRONIC SWITCHING SYSTEMS

**Objectives :**

The student will

- Understand the means of measuring traffic.
- Understand the implication of the traffic level on system design.

**UNIT -I:**

**Introduction:** Evolution of Telecommunications, Simple Telephone Communication, Basics of Switching System, Manual Switching System, Major Telecommunication Networks.

**Crossbar Switching:** Principles of Common Control, Touch Tone Dial Telephone, Principles of Crossbar Switching, Crossbar Switch Configurations, Cross point Technology, Crossbar Exchange Organization.

**UNIT -II:**

**Electronic Space Division Switching:** Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced Services, Two-Stage Networks, Three-Stage Networks, n- Stage Networks.

**Time Division Switching:** Basic Time Division Space Switching, Basic Time Division Time Switching, Time Multiplexed Space Switching, Time Multiplexed Time Switching, Combination Switching, Three-Stage Combination Switching, n- Stage Combination Switching.

**UNIT -III:**

**Telephone Networks:** Subscriber Loop System, Switching Hierarchy and Routing, Transmission Plan, Transmission Systems, Numbering Plan, Charging Plan, Signaling Techniques, In-channel Signaling, Common Channel Signaling, Cellular Mobile Telephony.

**Signaling:** Customer Line Signaling, Audio- Frequency Junctions and Trunk Circuits, FDM Carrier Systems, PCM Signaling, Inter- Register Signaling, Common- Channel Signaling Principles, CCITT Signaling System no.6, CCITT Signaling System no.7, Digital Customer Line Signaling.

**UNIT -IV:**

**Packet Switching:** Statistical Multiplexing, Local- Area and Wide- Area Networks, Large-scale Networks, Broadband Networks.

**Telecommunications Traffic:** The Unit of Traffic, Congestion, Traffic Measurement, A Mathematical Model, Lost-call Systems, Queuing Systems.

**UNIT -V:**

**Switching Networks:** Single- Stage Networks, Grading, Link Systems, Grades of service of link systems, Application of Graph Theory to link Systems, Use of Expansion, Call Packing,
Rearrange-able Networks, Strict- Sense non-blocking Networks, Sectionalized Switching Networks

**UNIT -VI:**

**Integrated Services Digital Network:** Motivation for ISDN, New Services, Network and Protocol Architecture, Transmission Channels, User- Network Interfaces, Signaling, Numbering and Addressing, Service Characterization, Interworking, ISDN Standards, Expert Systems in ISDN, Broadband ISDN, Voice Data Integration.

**TEXT BOOKS:**

1. Telecommunication Switching Systems and Networks- Thiagarajan Viswanathan, 2000, PHI.
2. Telecommunications Switching, Traffic and Networks- J. E. Flood, 2006, Pearson Education.

**REFERENCES:**

1. Digital Telephony- J. Bellamy, 2nd Edition, 2001, John Wiley.
2. Data Communications and Networks- Achyut S. Godbole, 2004, TMH.
3. Principles of Communication Ststems- H. Taub & D. Schilling, 2nd Edition, 2003, TMH.
4. Data Communication & Networking- B. A. Forouzan, 3rd Edition, 2004, TMH.
5. Telecommunication System Engineering – Roger L. Freeman, 4th Ed., Wiley-Inter Science, John Wiley & Sons, 2004.

**Outcomes**

The student will be able to

- Evaluate the time and space parameters of a switched signal
- Establish the digital signal path in time and space, between two terminals
- Evaluate the inherent facilities within the system to test some of the SLIC, CODEC and digital switch functions.
- Investigate the traffic capacity of the system.
- Evaluate methods of collecting traffic data.
- Evaluate the method of interconnecting two separate digital switches.

# ANALOG IC DESIGN

**( Elective I )**

**OBJECTIVES**

The student will be introduced to

- The student will be able to understand the behavior of MOS Devices and Small-Signal & Large-Signal Modeling of MOS Transistor and Analog Sub-Circuits.
- In this course, students can study CMOS Amplifiers like Differential Amplifiers, Cascode Amplifiers, Output Amplifiers, and Operational Amplifiers.
- Another main object of this course is to motivate the graduate students to design and to develop the Analog CMOS Circuits for different Analog operations.
- The concepts of Open-Loop Comparators and Different Types of Oscillators like Ring Oscillator, LC Oscillator etc.

**UNIT -I:**

**MOS Devices and Modeling:** The MOS Transistor, Passive Components-Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

**UNIT -II:**

**Analog CMOS Sub-Circuits:** MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

**UNIT -III:**

**CMOS Amplifiers:** Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

**UNIT -IV:**

**CMOS Operational Amplifiers:** Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

**UNIT -V:**

**Comparators:** Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

**UNIT -VI:**

**Oscillators & Phase-Locked Loops:** General Considerations, Ring Oscillators, LC Oscillators, Voltage Controlled Oscillators.

Simple PLL, Charge Pump PLLs, Non-Ideal Effects in PLLs, Delay Locked Loops, Applications.

**Text Books**:

1. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition.
2. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.

**References**:

1. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.
2. Analog Integrated Circuit Design- David A.Johns, Ken Martin, Wiley Student Edn, 2013.

**OUTCOMES**

After going through this course the student will be able to

- Understand the concepts of MOS Devices and Modeling.
- Design and analyze any Analog Circuits in real time applications.
- Extend the Analog Circuit Design to Different Applications in Real Time.
- Understand of Open-Loop Comparators and Different Types of Oscillators.

# OBJECT ORIENTED PROGRAMMING & OPERATING SYSTEM

**(Elective I )**

**Course Objectives:**

By the end of the course student will

- Describe the general architecture of computers
- Describe object oriented concepts
- Describe, contrast and compare differing structures for operating Systems
- Understand and analyze theory and implementation of: processes, resource control (concurrency etc.), physical and virtual memory, scheduling, I/O and files

**UNIT-I:**

**Introduction to OOP**

Introduction, Need of Object Oriented Programming, Principles of Object Oriented Languages, Procedural languages Vs OOP, Applications of OOP.

**UNIT-II:**

**Computer System and Operating System Overview:** Overview of computer operating systems, operating systems functions, protection and security, distributed systems, special purpose systems, operating systems structures and systems calls, operating systems generation.

**UNIT-III:**

**Process Management** – Process concept- process scheduling, operations, Inter process communication. Multi Thread programming models. Process scheduling criteria and algorithms, and their evaluation.

**UNIT-IV:**

**Memory Management:** Swapping, contiguous memory allocation, paging, structure of the page table, segmentation.

**UNIT-V:**

**Virtual Memory Management:**

virtual memory, demand paging, page-Replacement, algorithms, Allocation of Frames, Thrashing.

**UNIT-VI:**

**File system Interface-** the concept of a file, Access Methods, Directory structure, File system mounting, file sharing, protection.

**TEXT BOOKS:**

1. The Complete Reference Java, 8ed, Herbert Schildt, TMH.
2. Operating System Concepts- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley.
3. Operating Systems' – Internal and Design Principles Stallings, Sixth Edition–2005, Pearson education.

**REFERENCES:**

1. http://nptel.iitm.ac.in/courses/Webcourse-contents/IISc-BANG/Operating%20Systems/New_index1.html.
2. Operating systems- A Concept based Approach-D.M.Dhamdhere, 2nd Edition, TMH.
3. Operating System A Design Approach-Crowley, TMH.
4. Modern Operating Systems, Andrew S Tanenbaum 3rd edition PHI.

**Course Outcomes:**

By the end of the course student will be able to

- describe the general architecture of computers
- describe object oriented concepts
- describe, contrast and compare differing structures for operating Systems.
- understand and analyze theory and implementation of: processes, resource control (concurrency etc.), physical and virtual memory, scheduling, I/O and files.

# RADAR SYSTEMS

**(Elective-I)**

**OBJECTIVES**

The student will be introduced to

- the knowledge of different Antennas systems and communication equipment required for the operation of RADAR.
- different parameters of Transmitter and Receiver of RADAR
- the concept of Doppler Effect to measure parameters of RADAR.
- different types of RADARS and applications based on the type of Transmitters, Receivers, and their functions.

**Pre requisites: Antennas and wave propagation; Electromagnetics and Communications**

**UNIT – I**

Introduction: Nature of Radar. Maximum Unambiguous Range. Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Related Problems. Radar Equation: Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets-sphere, cone-sphere). Transmitter power.

**UNIT – II**

PRF and Range Ambiguities, System Losses (Qualitative treatment). Related Problems. CW and Frequency Modulated Radar: Doppler effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirement, Applications of CW radar. FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Measurement Errors, Multiple Frequency CW Radar.

**UNIT – III**

MTI and Pulse Doppler Radar: Introduction, Principle, MTIR Radar with-Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance. Non-coherent MTI, MTI versus Pulse Doppler Radar. Tracking Rader : Tracking with Rader, Sequential Lobing, Conical Scan, Mono-pulse Tracking.

**UNIT – IV**

Rader Amplitude Comparison Mono-pulse (one – and two –coordinates), Phase Comparison Mono-pulse. Target Reflection Characteristics and Angular Accuracy. Tracking in Range Acquisition and Scanning Patterns. Comparison of Trackers. Radar Antennas – Antenna Parameters, Reflector Antennas, Lens Antennas, Lens Antennas Cosecant- Squared Antenna Pattern, Radomes.

**UNIT- V**

Electronically Steered Phased Array Antennas, Phase Shifters, Frequency – scan Arrays, Radiation for Phased Array, Architecture for Phased Arrays. Detection of Radar Signals in Noise: Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation detection, Detection criteria, Detector Characteristics, Automatic Detection, Constant False Alarm Rate Receiver

**UNIT – VI**

Radar Receivers – Noise Figure and Noise Temperature. Displays – types. Duplexer – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas- Basic Concepts, Radiation Pattern. Beam Steering and Beam Width changes, Series versus Parallel Feeds. Applications, Advantages and Limitations.

**TEXT BOOKS:**

1. Introduction to Radar Systems – Merrill I. Skolnik, SECOND EDITION, McGraw – Hill, 1981.
2. Radar Engineering and fundamentals of Navigational Aids-G.S.N.Raju, I.K International, 2008.

**REFERENCES:**

1. Introduction to Radar Systems – Merrill I. Skolnik, THIRD EDITION, Tata McGraw – Hill, 2001.
2. Radar: Principles, Technologies, Applications- Byron Edde, Pearson Education.

**OUTCOMES**

After going through this course the student will be able to

- Acquire the knowledge to apply and to design required parameters for a RADAR system.
- Apply the techniques learned, to choose suitable RADAR from the available, for the required application.

# ADVANCED COMPUTER ARCHITECTURE

**( Elective I )**

**UNIT -I:**

**Fundamentals of Computer Design:**

Fundamentals of Computer design, Changing faces of computing and task of computer designer, Technology trends, Cost price and their trends, Measuring and reporting performance, Quantitative principles of computer design, Amdahl's law.

Instruction set principles and examples- Introduction, Classifying instruction set- MEmory addressing- type and size of operands, Operations in the instruction set.

**UNIT –II:**

**Pipelines:**

Introduction, Basic RISC instruction set, Simple implementation of RISC instruction set, Classic five stage pipe lined RISC processor, Basic performance issues in pipelining, Pipeline hazards, Reducing pipeline branch penalties.

**Memory Hierarchy Design:**

Introduction, Review of ABC of cache, Cache performance, Reducing cache miss penalty, Virtual memory.

**UNIT -III:**

**Instruction Level Parallelism the Hardware Approach:**

Instruction-Level parallelism, Dynamic scheduling, Dynamic scheduling using Tomasulo's approach, Branch prediction, high performance instruction delivery- hardware based speculation.

**UNIT-IV**

**ILP Software Approach**

Basic compiler level techniques, Static branch prediction, VLIW approach, Exploiting ILP, Parallelism at compile time, Cross cutting issues -Hardware verses Software.

**UNIT –V:**

**Multi Processors and Thread Level Parallelism:**

Multi Processors and Thread level Parallelism- Introduction, Characteristics of application domain, Systematic shared memory architecture, Distributed shared – memory architecture, Synchronization.

**UNIT –VI:**

**Inter Connection and Networks:**

Introduction, Interconnection network media, Practical issues in interconnecting networks, Examples of inter connection, Cluster, Designing of clusters.

**Intel Architecture:** Intel IA-64 ILP in embedded and mobile markets Fallacies and pit falls.

**TEXT BOOKS:**

1. John L. Hennessy, David A. Patterson - Computer Architecture: A Quantitative Approach, 3rd Edition, An Imprint of Elsevier.

**REFERENCES:**

1. John P. Shen and Miikko H. Lipasti - Modern Processor Design : Fundamentals of Super Scalar Processors
2. Computer Architecture and Parallel Processing - Kai Hwang, Faye A.Brigs., MC Graw Hill.
3. Advanced Computer Architecture - A Design Space Approach - Dezso Sima, Terence Fountain, Peter Kacsuk , Pearson Ed.

**IV Year – I SEMESTER**

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**Elective II**

# OPTICAL COMMUNICATIONS

**OBJECTIVES**

The student will be introduced to

- the functionality of each of the components that comprise a fiber-optic communication system
- the properties of optical fiber that affect the performance of a communication link and types of fiber materials with their properties and the losses occur in fibers.
- the principles of single and multi-mode optical fibers and their characteristics
- working of semiconductor lasers, and differentiate between direct modulation and external electro-optic modulation.
- Analyze the operation of LEDs, laser diodes, and PIN photo detectors (spectral properties, bandwidth, and circuits) and apply in optical systems.
- Analyze and design optical communication and fiber optic sensor systems.
- the models of analog and digital receivers.

**UNIT I**

Overview of optical fiber communication - Historical development, The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, Cylindrical fibers- Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers, Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index, Related problems.

**UNIT II**

Fiber materials:- Glass, Halide, Active glass, Chalgenide glass, Plastic optical fibers. Signal distortion in optical fibers-Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses, Information capacity

determination, Group delay, Types of Dispersion:- Material dispersion, Wave-guide dispersion, Polarization-Mode dispersion, Intermodal dispersion, Pulse broadening in Graded index fiber, Related problems.

**UNIT III**

Optical fiber Connectors-Connector types, Single mode fiber connectors, Connector return loss, Fiber Splicing- Splicing techniques, Splicing single mode fibers, Fiber alignment and joint loss- Multimode fiber joints, single mode fiber joints.

**UNIT IV**

Optical sources- LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Injection Laser Diodes- Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, Resonant frequencies, Reliability of LED&ILD, Optical detectors-Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors, Related problems.

**UNIT V**

Source to fiber power launching - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling, Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of Error, Quantum limit, Analog receivers.

**UNIT VI**

Optical system design - Point-to- point links- Component choice and considerations, Link power budget, Rise time budget with examples, Line coding in Optical links, WDM, Necessity, Principles, Measurement of Attenuation and Dispersion, Eye pattern.

**TEXT BOOKS :**

1. Optical Fiber Communications – Gerd Keiser, Mc Graw-Hill International edition, 3rd Edition, 2000.
2. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.

**RERFERENCES :**

1. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education,2005.
2. Text Book on Optical Fiber Communication and its Applications – S.C.Gupta, PHI, 2005.

3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Ediition, 2004.
4. Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education, 2004.

**OUTCOMES**

After going through this course the student will be able to

- Choose necessary components required in modern optical communications systems .
- Design and build optical fiber experiments in the laboratory, and learn how to calculate electromagnetic modes in waveguides, the amount of light lost going through an optical system, dispersion of optical fibers.
- Use different types of photo detectors and optical test equipment to analyze optical fiber and light wave systems.
- Choose the optical cables for better communication with minimum losses
- Design, build, and demonstrate optical fiber experiments in the laboratory.

# DIGITAL IC DESIGN

**( Elective II )**

**OBJECTIVES**

- The student will be able to understand the MOS Design.
- In this course, students can study Combinational MOS Logic Circuits and Sequential MOS Logic Circuits.
- Another main object of this course is to motivate the graduate students to design and to develop the Digital Integreated Circuits for different Applications.
- The concepts of Semiconductor Memories, Flash Memory, RAM array organization.

**UNIT-I:**

**MOS Design:** Pseudo NMOS Logic – Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

**UNIT-II:**

**Combinational MOS Logic Circuits**: MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates, AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.

**UNIT-III:**

**Sequential MOS Logic Circuits:** Behaviour of bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.

**UNIT-IV:**

**Dynamic Logic Circuits:** Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.

**UNIT-V:**

**Interconnect:** Capacitive Parasitics, Resistive Parasitics, Inductive Parasitics, Advanced Interconncet Techniques.

**UNIT-VI:**

**Semiconductor Memories:** Memory Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory-NOR flash and NAND flash.

**Text Books:**

1. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2nd Ed., PHI.

2. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.

**References:**

1. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.
2. CMOS VLSI Design – Neil H.E Weste, David harris, Ayan Banerjee 3rd Edition, Pearson

**OUTCOMES**

After going through this course the student will be able to

- Understand the concepts of MOS Design.
- Design and analysis of Combinational and Sequential MOS Circuits.
- Extend the Digital IC Design to Different Applications.
- Understand the Concepts of Semiconductor Memories, Flash Memory, RAM array organization.

# SPEECH PROCESSING

## (ELECTIVE – II)

**UNIT –I:**

**Fundamentals of Digital Speech Processing**:

Anatomy & Physiology of Speech Organs, The process of Speech Production, Acoustic Phonetics, Articulatory Phonetics, The Acoustic Theory of Speech Production- Uniform lossless tube model, effect of losses in vocal tract, effect of radiation at lips, Digital models for speech signals.

**UNIT –II:**

**Time Domain Models for Speech Processing:**

Introduction- Window considerations, Short time energy and average magnitude Short time average zero crossing rate, Speech Vs Silence discrimination using energy and zero crossing, Pitch period estimation using a parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

**UNIT –III:**

**Linear Predictive Coding (LPC) Analysis:**

Basic principles of Linear Predictive Analysis: The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky Decomposition Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equations, Comparison between the Methods of Solution of the LPC Analysis Equations, Applications of LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

**UNIT –IV:**

**Homomorphic Speech Processing:**

Introduction, Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, Pitch Detection, Formant Estimation, The Homomorphic Vocoder.

**UNIT-V**

**Speech Enhancement:**

Nature of interfering sounds, Speech enhancement techniques: Single

Microphone Approach : spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter, Multi microphone Approach.

**UNIT-VI:**

**Automatic Speech & Speaker Recognition:**

Basic pattern recognition approaches, Parametric representation of speech, Evaluating the similarity of speech patterns, Isolated digit Recognition System, Continuous digit Recognition System.

**Hidden Markov Model (HMM) for Speech:**

Hidden Markov Model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMS,

**Speaker Recognition:**

Recognition techniques, Features that distinguish speakers, Speaker Recognition Systems: Speaker Verification System, Speaker Identification System.

**TEXT BOOKS:**

1. Digital Processing of Speech Signals - L.R. Rabiner and S. W. Schafer. Pearson Education.
2. Speech Communications: Human & Machine - Douglas O'Shaughnessy, 2nd Ed., Wiley India, 2000.
3. Digital Processing of Speech Signals. L.R Rabinar and R W Jhaung, 1978, Pearson Education.

**REFERENCE BOOKS:**

1. Discrete Time Speech Signal Processing: Principles and Practice - Thomas F. Quateri, 1st Ed., PE.
2. Speech & Audio Signal Processing- Ben Gold & Nelson Morgan, 1st Ed., Wiley.

# Artificial Neural Networks and Fuzzy Logic

**(Elective II )**

## 1. Introduction to Neural Networks

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Potential Applications of ANN.

### Essentials of Artificial Neural Networks

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN-Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application.

## 2. Feed Forward Neural Networks

Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training

Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence

theorem, Limitations of the Perceptron Model, Applications.

Multilayer Feed Forward Neural Networks

Credit Assignment Problem, Generalized Delta Rule, Derivation of Back-propagation (BP)

Training, Summary of Back-propagation Algorithm, Kolmogorov Theorem, Learning

Difficulties and Improvements.

## 3. Associative Memories

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory, Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm,

BAM Energy Function, Proof of BAM Stability Theorem. Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network.

4. **Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART)**

Introduction, Competitive Learning, Vector Quantization, Self-Organized Learning Networks, Kohonen Networks, Training Algorithms, Linear Vector Quantization, Stability- Plasticity Dilemma, Feed forward competition, Feedback Competition, Instar, Outstar, ART1, ART2, Applications.

**5. Classical & Fuzzy Sets**

Introduction to classical sets – properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, Properties, fuzzy relations, cardinalities, membership functions.

**6. Fuzzy Logic System Components**

Fuzzification, Membership Value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

**Applications :**

Neural network applications: Process identification, Fraction Approximation, Control and Process Monitoring, Fault diagnosis and Load forecasting.

Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

**Text Books:**

1. Neural Netwroks, Fuzy logic , Gnenetic algorithms: synthesis and applications by Rajasekharan and Rai- PHI Publication.
2. Introduction to Artificial Neural Systems- Jacek M.Zurada, Jaico Publishing House, 1997.

**Reference Books:**

1. Neural and Fuzzy Systems: Foundation, Architectures and Applications, - N. Yadaiah and S. Bapi Raju, Pearson Education
2. Neural Netwroks – James A Freeman and Davis Skapura, Pearson, 2002
3. Neural Netwroks – Simon Hykins, Pearson Education.
4. Neural Engineering by C. Eliasmith and CH. Anderson, PHI.

   Neural Netwroks and Fuzzy Logic System by Brok Kosko, PHI Publications.

## NETWORK SECURITY & CRYPTOGRAPHY
## (Elective-II)

**Course objectives:**

The main objective of this course is to teach students to understand and how to address various software security problems in a secure and controlled environment. During this course the students will gain knowledge (both theoretical and practical) in various kinds of software security problems, and techniques that could be used to protect the software from security threats. The students will also learn to understand the "modus operandi" of adversaries; which could be used for increasing software dependability.

**Course outcomes:**

1. be able to individually reason about software security problems and protection techniques on both an abstract and a more technically advanced level.
2. be able to individually explain how software exploitation techniques, used by adversaries, function and how to protect against them.

**Syllabus:**

**UNIT I : Classical Encryption Techniques**

**Objectives:** *The Objectives of this unit is to present an overview of the main concepts of cryptography, understand the threats & attacks, understand ethical hacking.*

**Introduction:** Security attacks, services & mechanisms, Symmetric Cipher Model, Substitution Techniques, Transportation Techniques, Cyber threats and their defense (Phishing Defensive measures, web based attacks, SQL injection & Defense techniques) TEXT BOOK 2), Buffer overflow & format string vulnerabilities, TCP session hijacking (ARP attacks, route table modification) UDP hijacking (man-in-the-middle attacks) (TEXT BOOK3).

**UNIT II: Block Ciphers & Symmetric Key Cryptography**

**Objectives:** The Objectives of this unit is to understand the difference between stream ciphers & block ciphers, present an overview of the Feistel Cipher and explain the encryption and decryption, present an overview of DES, Triple DES, Blowfish, IDEA.

Traditional Block Cipher Structure, DES, Block Cipher Design Principles,

AES-Structure, Transformation functions, Key Expansion, Blowfish, CAST-128, IDEA, Block Cipher Modes of Operations.

**UNIT III: Number Theory & Asymmetric Key Cryptography**
**Objectives:** *Presents the basic principles of public key cryptography, Distinct uses of public key cryptosystems.*

**Number Theory:** Prime and Relatively Prime Numbers, Modular Arithmetic, Fermat's and Euler's Theorems, The Chinese Remainder theorem, Discrete logarithms.

**Public Key Cryptography**: Principles, public key cryptography algorithms, RSA Algorithms, Diffie Hellman Key Exchange, Elgamal encryption & decryption, Elliptic Curve Cryptography.

**UNIT IV : Cryptographic Hash Functions & Digital Signatures**

**Objectives:** *Present overview of the basic structure of cryptographic functions, Message Authentication Codes, Understand the operation of SHA-512, HMAC, Digital Signature*

Application of Cryptographic hash Functions, Requirements & Security, Secure Hash Algorithm, Message Authentication Functions, Requirements & Security, HMAC & CMAC. Digital Signatures, NIST Digital Signature Algorithm. Key management & distribution.

**UNIT V: User Authentication, Transport Layer Security & Email Security**

**Objectives:** Present an overview of techniques for remote user authentication, Kerberos, Summarize Web Security threats and Web traffic security approaches, overview of SSL & TLS. Present an overview of electronic mail security.

**User Authentication:** Remote user authentication principles, Kerberos
**Transport Level Security:** Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Shell(SSH)
**Electronic Mail Security:** Pretty Good Privacy (PGP) and S/MIME.

**UNIT VI: IP Security & Intrusion Detection Systems**
**Objectives:** Provide an overview of IP Security, concept of security association, Intrusion Detection Techniques

**IP Security:** IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

**Intrusion detection**: Overview, Approaches for IDS/IPS, Signature based IDS, Host based IDS/IPS. (TEXT BOOK 2)

**TEXT BOOKS:**

1. Cryptography & Network Security: Principles and Practices, William Stallings, PEA, Sixth edition.
2. Introduction to Computer Networks & Cyber Security, Chwan Hwa Wu, J.David Irwin, CRC press.
3. Hack Proofing your Network, Russell, Kaminsky, Forest Puppy, Wiley Dreamtech.

**REFERENCE BOOKS:**

1. Everyday Cryptography, Fundamental Principles & Applications, Keith Martin, Oxford.
2. Network Security & Cryptography, Bernard Menezes, Cengage, 2010.

**IV Year – I SEMESTER**

| T | P | C |
|---|---|---|
| 0 | 3 | 2 |

## VLSI Laboratory

The students are required to design the schematic diagrams using CMOS logic and to draw the layout diagrams to perform the following experiments using CMOS 130nm Technology with necessary EDA tools (Mentor Graphics/Tanner).

**List of Experiments:**

1. Design and implementation of an inverter
2. Design and implementation of universal gates
3. Design and implementation of full adder
4. Design and implementation of full subtractor
5. Design and implementation of RS-latch
6. Design and implementation of D-latch
7. Design and implementation asynchronous counter
8. Design and Implementation of static RAM cell
9. Design and Implementation of differential amplifier
10. Design and Implementation of ring oscillator

**Equipment Required:**

1. Mentor Graphics/Tanner software-latest version
2. Personal computer with necessary peripherals.

**IV Year – I SEMESTER**

| T | P | C |
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| 0 | 3 | 2 |

## MICROWAVE ENGINEERING LAB

**Minimum Twelve Experiments to be conducted:**

**Part – A (Any 7 Experiments) :**

1. Reflex Klystron Characteristics.
2. Gunn Diode Characteristics.
3. Attenuation Measurement.
4. Directional Coupler Characteristics.
5. VSWR Measurement.
6. Impedance and Frequency Measurement.
7. Waveguide parameters measurement.
8. Scattering parameters of Circulator.
9. Scattering parameters of Magic Tee.

**Part – B (Any 5 Experiments ) :**

10. Characterization of LED.
11. Characterization of Laser Diode.
12. Intensity modulation of Laser output through an optical fiber.
13. Measurement of Data rate for Digital Optical link.
14. Measurement of NA.
15. Measurement of losses for Analog Optical link.

**Equipment required for Laboratories:**

1. Regulated Klystron Power Supply
2. VSWR Meter -
3. Micro Ammeter - 0 – 500 μA
4. Multi meter
5. CRO
6. GUNN Power Supply, Pin Modulator
7. Reflex Klystron

8. Crystal Diodes
9. Micro wave components (Attenuation)
10. Frequency Meter
11. Slotted line carriage
12. Probe detector
13. wave guide shorts
14. Pyramidal Horn Antennas
15. Directional Coupler
16. E, H, Magic Tees
17. Circulators, Isolator
18. Matched Loads
19. Fiber Optic Analog Trainer based LED
20. Fiber Optic Analog Trainer based laser
21. Fiber Optic Digital Trainer
22. Fiber cables - (Plastic, Glass)

**IV Year – II SEMESTER**

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|---|---|---|
| 3+1 | 0 | 3 |

## CELLULAR AND MOBILE COMMUNICATIONS

**UNIT I**

**CELLULAR MOBILE RADIO SYSTEMS:** Introduction to Cellular Mobile System, Performance criteria, uniqueness of mobile radio environment, operation of cellular systems, Hexagonal shaped cells, Analog and Digital Cellular systems.

**ELEMENTS OF CELLULAR RADIO SYSTEM DESIGN :** General description of the problem, concept of frequency channels, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system, Cell splitting, consideration of the components of Cellular system.

**UNIT II**

**INTERFERENCE :** Introduction to Co-Channel Interference, real time Co-Channel interference, Co-Channel measurement, design of Antenna system, Antenna parameters and their effects, diversity receiver, non-cochannel interference-different types. **CELL COVERAGE FOR SIGNAL AND TRAFFIC:** Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long distance propagation antenna height gain, form of a point to point model.

**UNIT III**

**CELL SITE AND MOBILE ANTENNAS :** Sum and difference patterns and their synthesis, omni directional antennas, directional antennas for interference reduction, space diversity antennas, umbrella pattern antennas, minimum separation of cell site antennas, high gain antennas.

**UNIT IV**

**FREQUENCY MANAGEMENT AND CHANNEL ASSIGNMENT:** Numbering and grouping, setup access and paging channels channel assignments to cell sites and mobile units, channel sharing and borrowing, sectorization, overlaid cells, non fixed channel assignment.

**UNIT V**

Handoff, dropped calls and cell splitting, types of handoff, handoff invitation, delaying handoff, forced handoff, mobile assigned handoff. Intersystem handoff, cell splitting, micro cells, vehicle locating methods, dropped call rates and their evaluation.

**UNIT VI**

**DIGITAL CELLULAR NETWORKS :** GSM architecture, GSM channels, multiplex access scheme, TDMA, CDMA.

**TEXTBOOKS :**

1. Mobile Cellular Telecommunications – W.C.Y. Lee, Tata McGraw Hill, 2rd Edn., 2006.
2. Principles of Mobile Communications – Gordon L. Stuber, Springer International 2nd Edition, 2007.

**REFERENCES :**

**1.** Wireless Communications - Theodore. S. Rapport, Pearson education, 2nd Edn., 2002.
**2.** Wireless and Mobile Communications – Lee McGraw Hills, 3rd Edition, 2006.
3. Mobile Cellular Communication – G Sasibhushana Rao Pearson
**3.** Wireless Communication and Networking – Jon W. Mark and Weihua Zhqung, PHI, 2005.
**4.** Wireless Communication Technology – R. Blake, Thompson Asia Pvt. Ltd., 2004.

**IV Year – II SEMESTER**

| T | P | C |
|---|---|---|
| 3+1 | 0 | 3 |

## ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

### UNIT I

Performance characteristics of instruments, Static characteristics, Accuracy, Resolution, Precision, Expected value, Error, Sensitivity. Errors in Measurement, Dynamic Characteristics-speed of response, Fidelity, Lag and Dynamic error. DC Voltmeters- Multi-range, Range extension/Solid state and differential voltmeters, AC voltmeters- multi range, range extension, shunt. Thermocouple type RF ammeter, Ohmmeters series type, shunt type, Multi-meter for Voltage, Current and resistance measurements.

### UNIT II

Signal Generator- fixed and variable, AF oscillators, Standard and AF sine and square wave signal generators, Function Generators, Square pulse, Random noise, sweep, Arbitrary waveform. Wave Analyzers, Harmonic Distortion Analyzers, Spectrum Analyzers, Digital Fourier Analyzers.

### UNIT III

Oscilloscopes CRT features, vertical amplifiers, horizontal deflection system, sweep, trigger pulse, delay line, sync selector circuits, simple CRO, triggered sweep CRO, Dual beam CRO, . Dual trace oscilloscope, sampling oscilloscope, storage oscilloscope, digital readout oscilloscope, digital storage oscilloscope, Lissajous method of frequency measurement, standard specifications of CRO, probes for CRO- Active & Passive, attenuator type.

### UNIT IV

AC Bridges Measurement of inductance- Maxwell's bridge, Anderson bridge. Measurement of capacitance -Schearing Bridge. Wheat stone bridge. Wien Bridge, Errors and precautions in using bridges. Q-meter.

### UNIT V

Transducers- active & passive transducers : Resistance, Capacitance, inductance; Strain gauges, LVDT, Piezo Electric transducers, Resistance Thermometers, Thermocouples, Thermistors, Sensistors.

**UNIT VI**

Measurement of physical parameters force, pressure, velocity, humidity, moisture, speed, proximity and displacement. Data acquisition systems.

**TEXTBOOKS :**

1. Electronic instrumentation, second edition - H.S.Kalsi, Tata McGraw Hill, 2004.
2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.

**REFERENCES :**

1. Electronic Instrumentation & Measurements - David A. Bell, PHI, 2nd Edition, 2003.
2. Electronic Test Instruments, Analog and Digital Measurements - Robert A.Witte, Pearson Education, 2nd Ed., 2004.
3. Electronic Measurements & Instrumentations by K. Lal Kishore, Pearson Education - 2005.

**OUTCOMES**

The student will be able to

- Select the instrument to be used based on the requirements.
- Understand and analyze different signal generators and analyzers.
- Understand the design of oscilloscopes for different applications.
- Design different transducers for measurement of different parameters.

**IV Year – II SEMESTER**

| T | P | C |
|---|---|---|
| 3+1 | 0 | 3 |

**ELECTIVE – III**

# SATELLITE COMMUNICATIONS

**UNIT I**

**INTRODUCTION :** Origin of Satellite Communications, Historical Background, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications.

**UNIT II**

**ORBITAL MECHANICS AND LAUNCHERS:** Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance.

**UNIT III**

**SATELLITE SUBSYSTEMS :** Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification.

**UNIT IV**

**SATELLITE LINK DESIGN :** Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.

**MULTIPLE ACCESS:** Frequency division multiple access (FDMA) Intermodulation, Calculation of C/N. Time division Multiple Access (TDMA) Frame structure, Examples. Satellite Switched TDMA Onboard processing, DAMA, Code Division Multiple access (CDMA),Spread spectrum transmission and reception.

**UNIT V**

**EARTH STATION TECHNOLOGY :** Introduction, Transmitters, Receivers, Antennas, Tracking systems, Terrestrial interface, Primary power test methods.

**LOW EARTH ORBIT AND GEO-STATIONARY SATELLITE SYSTEMS:** Orbit consideration, coverage and frequency considerations,

Delay & Throughput considerations, System considerations, Operational NGSO constellation Designs

**UNIT VI**

**SATELLITE NAVIGATION & THE GLOBAL POSITIONING SYSTEM [1] :** Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers and codes, Satellite signal acquisition, GPS Navigation Message, GPS signal levels, GPS receiver operation, GPS C/A code accuracy, Differential GPS.

**TEXT BOOKS:**

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.
2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G.Suyderhoud, 2nd Edition, Pearson Publications, 2003.

**REFERENCES :**

1. Satellite Communications : Design Principles – M. Richharia, BS Publications, 2nd Edition, 2003.
2. Satellite Communication - D.C Agarwal, Khanna Publications, 5th Ed.
3. Fundamentals of Satellite Communications – K.N. Raja Rao, PHI, 2004
4. Satellite Communications – Dennis Roddy, McGraw Hill, 2nd Edition, 1996.

# MIXED SIGNAL DESIGN

## (ELECTIVE – III)

**OBJECTIVES**

The student will be introduced to

- Understand the Switched capacitors Circuits and Operation and Analysis, PLLS.
- In this course, students can study Data Converter Fundamentals, Nyquist Rate A/D Converters.
- Another main object of this course is to motivate the graduate students to study and to analyze the Oversampling Converters and Continuous-Time Filters.
- The concepts of Continuous-Time Filters**,** CMOS Transconductors Using Triode and Active Transistors and MOSFET-C Filters.

**UNIT-I:**

**Switched Capacitor Circuits:** Introduction to Switched Capacitor circuits-basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators first order filters, Switch sharing, biquad filters.

**UNIT-II:**

**Phased Lock Loop (PLL):** Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs-PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications.

**UNIT-III:**

**Data Converter Fundamentals:** DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters

**UNIT-IV:**

**Nyquist Rate A/D Converters:** Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time-interleaved converters.

**UNIT-V:**

**Oversampling Converters:** Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multi-bit quantizers, Delta sigma D/A

**UNIT-VI:**

**Continuous-Time Filters:** Introduction to Gm-C Filters, Bipolar Transconductors, CMOS transconductors Using Triode and Active Transistors, BiCMOS Tran conductors, MOSFET-C Filters.

**Text Books:**

1. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition, 2002
2. Analog Integrated Circuit Design- David A. Johns,Ken Martin, Wiley Student Edition, 2013

**Reference Books:**

1. CMOS Mixed-Signal Circuit Design - R. Jacob Baker, Wiley Interscience, 2009.
2. CMOS Analog Circuit Design –Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.

**OUTCOMES**

After going through this course the student will be able to

- Understand the concepts of Switched Capacitor circuits.
- Design and analysis of Nyquist Rate A/D Converters.
- Extend the Mixed Signal Design to Different Applications.
- Concepts of Oversampling Converters and Continuous-Time Filters.

# EMBEDDED SYSTEMS

**(ELECTIVE – III)**

**OBJECTIVES**

After going through this course the student will be able to

- Understand the building blocks of typical embedded system and different memory technology and memory types.
- Learn the characteristics of an embedded system, quality attributes of embedded systems, application specific and domain specific embedded system,
- Learn about communication devices and basics about VLSI and integrated circuit design and learn concept of firmware design approaches, ISR concept. Interrupt sources, interrupt servicing mechanism, multiple interrupts,
- Understand the concepts of c versus embedded c and compiler versus cross-compiler.
- Learn about the integrated development environment, software utility tool. Also learn about quality assurance and testing of the design, testing on host machine, simulators.

**Unit-I:**

**Introduction:** Embedded System-Definition, History, Classification, application areas and purpose of embedded systems, The typical embedded system-Core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, PCB and passive components. Characteristics, Quality attributes of an Embedded systems, Application-specific and Domain-Specific examples of an embedded system.

**Unit-II:**

**Embedded Hardware Design:** Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock.

**Unit-III:**

**Embedded Firmware Design:** Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.

**Unit-IV:**

**Real Time Operating System:** Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Threads, Processes and Scheduling, Task Scheduling, Communication, Synchronization, Device Drivers, How to choose an RTOS.

**Hardware Software Co-Design:** Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware, ICE.

**Unit-V:**

**Embedded System Development:** The integrated development environment, Types of files generated on cross-compilation, Deassembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools.

**Unit-VI:**

**Embedded System Implementation And Testing:** The main software utility tool, CAD and the hardware, Translation tools-Pre-processors, Interpreters, Compilers and Linkers, Debugging tools, Quality assurance and testing of the design, Testing on host machine, Simulators, Laboratory Tools.

**Text Books:**

1. Embedded Systems Architecture By Tammy Noergaard, Elsevier Publications, 2005
2. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications.

**References:**

1. Embedded Systems, Raj Kamal-Tata McGraw Hill Education Private Limited, Second Edition, 2008
2. Embedding system building blocks By Labrosse, CMP publishers.

**OUTCOMES**

After going through this course the student will be able to

- Know basics of embedded system, classification, memories, different communication interface and what embedded firmware is and its role in embedded system, different system components.
- Distinguish all communication devices in embedded system, other peripheral device.
- Distinguish concepts of C versus embedded C and compiler versus cross-compiler.
- Choose an operating system, and learn how to choose an RTOS

# RF CIRCUIT DESIGN

## (ELECTIVE – III)

**UNIT -I:**

**Introduction to RF Electronics:**

The Electromagnetic Spectrum, units and Physical Constants, Microwave bands – RF behavior of Passive components: Tuned resonant circuits, Vectors, Inductors and Capacitors - Voltage and Current in capacitor circuits – Tuned RF / IF Transformers.

**UNIT -II:**

**Transmission Line Analysis:** Examples of transmission lines- Transmission line equations and Biasing- Micro Strip Transmission Lines- Special Termination Conditions- sourced and Loaded Transmission Lines. **Single And Multiport Networks:** The Smith Chart, Interconnectivity networks, Network properties and Applications, Scattering Parameters.

**UNIT -III:**

**Matching and Biasing Networks:**

Impedance matching using discrete components – Micro strip line matching networks, Amplifier classes of Operation and Biasing networks.

**UNIT-IV**

**RF Passive & Active Components:** Filter Basics – Lumped filter design – Distributed Filter Design – Diplexer Filters- Crystal and Saw filters- Active Filters - Tunable filters – Power Combiners / Dividers – Directional Couplers – Hybrid Couplers – Isolators. RF Diodes – BJTs- FETs- HEMTs and Models.

**UNIT -V:**

**RF Transistor Amplifier Design:** Characteristics of Amplifiers - Amplifier Circuit Configurations, Amplifier Matching Basics, Distortion and noise products, Stability Considerations, Small Signal amplifier design, Power amplifier design, MMIC amplifiers, Broadband High Power multistage amplifiers, Low noise amplifiers, VGA Amplifiers.

**UNIT -VI:**

**Oscillators:** Oscillator basics, Low phase noise oscillator design, High frequency Oscillator configuration, LC Oscillators, VCOs, Crystal Oscillators, PLL Synthesizer, and Direct Digital Synthesizer. **RF Mixers:**

Basic characteristics of a mixer - Active mixers- Image Reject and Harmonic mixers, Frequency domain considerations.

**TEXT BOOKS:**

1. RF Circuit design: Theory and applications by Reinhold Ludwing, Pavel Bretchko. Pearson Education Asia Publication, New Delhi 2001.
2. Radio Frequency and Microwave Communication Circuits – Analysis and Design – Devendra K. Misra, Wiley Student Edition, John Wiley & Sons

**REFERENCE BOOKS:**

1. Radio frequency and Microwave Electronics - Mathew M.Radmangh, 2001, PE Asia Publ.
2. RF Circuit Design – Christopher Bowick, Cheryl Aljuni and John Biyler, Elsevier Science, 2008.
3. Secrets of RF Design - Joseph Carr., 3rd Edition, Tab Electronics.
4. Complete Wireless Design - Cotter W. Sawyer, 2nd Edition, Mc-Graw Hill.
5. Practical RF Circuit Design for Modem Wireless Systems Vol.2 -Less Besser and Rowan Gilmore.

# Cloud Computing
## (ELECTIVE – III)

**Course Objectives:** The student will learn about the cloud environment, building software systems and components that scale to millions of users in modern internet, cloud concepts capabilities across the various cloud service models including Iaas, Paas, Saas, and developing cloud based software applications on top of cloud platforms.

**Course Outcomes:**

1. Understanding the key dimensions of the challenge of Cloud Computing.
2. Assessment of the economics , financial, and technological implications for selecting cloud computing for own organization.
3. Assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications.
4. Assessment of own organizations' needs for capacity building and training in cloud computing-related IT areas.

**Syllabus:**

**UNIT I: Systems modeling, Clustering and virtualization:**

Scalable Computing over the Internet, Technologies for Network based systems, System models for Distributed and Cloud Computing, Software environments for distributed systems and clouds, Performance, Security And Energy Efficiency.

**UNIT II: Virtual Machines and Virtualization of Clusters and Data Centers:**

Implementation Levels of Virtualization, Virtualization Structures/ Tools and mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation.

**UNIT III: Cloud Platform Architecture:**

Cloud Computing and service Models, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms, Inter Cloud Resource Management, Cloud Security and Trust Management. Service Oriented Architecture, Message Oriented Middleware.

**UNIT IV: Cloud Programming and Software Environments:**

Features of Cloud and Grid Platforms, Parallel & Distributed Programming Paradigms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments.

**UNIT V: Cloud Resource Management and Scheduling:**

Policies and Mechanisms for Resource Management Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds, Fair Queuing, Start Time Fair Queuing, Borrowed Virtual Time, Cloud Scheduling Subject to Deadlines, Scheduling Map Reduce Applications Subject to Deadlines.

**UNIT VI:**

**Storage Systems:** Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system., Apache Hadoop, Big Table, Megastore, Amazon Simple Storage Service (S3) .

**TEXT BOOKS:**

1. Distributed and Cloud Computing, Kai Hwang, Geoffry C. Fox, Jack J. Dongarra MK Elsevier.
2. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.
3. Cloud Computing, A Hands on approach, Arshadeep Bahga, Vijay Madisetti, University Press.

**REFERNCE BOOK:**

1. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH.
2. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammarai selvi, TMH.

**IV Year – II SEMESTER**

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**ELECTIVE - IV**

# WIRELESS SENSORS AND NETWORKS

**UNIT I**

**OVERVIEW OF WIRELESS SENSOR NETWORKS:**

Key definitions of sensor networks, Advantages of sensor Networks, Unique constraints an challenges, Driving Applications, Enabling Technologies for Wireless Sensor Networks.

**ARCHITECTURES**:

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

**UNIT II**

**NETWORKING Technologies**:

Physical Layer and Transceiver Design Considerations, Personal area networks (PANs), hidden node and exposed node problem, Topologies of PANs, MANETs, WANETs.

**UNIT-III**

**MAC Protocols for Wireless Sensor Networks**:

Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

**UNIT-IV**

**ROUTING PROTOCOLS**:

Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols, Proactive Routing.

**UNIT-V**

**TRANSPORT LAYER AND 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 Protocol for Ad Hoc Wireless Networks.

**UNIT- VI**

**SECURITY IN WSNs**:

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.

**SENSOR NETWORK PLATFORMS AND TOOLS**:

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

**APPLICATIONS of WSN:**

**S** Ultra wide band radio communication, Wireless fidelity systems. Future directions, Home automation, smart metering Applications.

**TEXT BOOKS:**

1. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B.S.Manoj, 2004, PHI
2. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control – Jagannathan Sarangapani, CRC Press
3. Holger Karl & Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.

**REFERENCES:**

1. . Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols, and Applications”, John Wiley, 2007.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
3. Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh ,1 ed. Pearson Education.
4. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer.
5. Wireless Sensor Networks – S Anandamurugan , Lakshmi Publications

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# SYSTEM ON CHIP

## (ELECTIVE - IV)

**OBJECTIVES**

After going through this course the student will be able to

- Understand the System Architecture and Processor Architecture, approach for a SOC Design.
- Learn the, Basic concepts in Processor Micro Architecture, and Learn Different Types of Processors like VLIW Processors, Superscalar Processors etc.
- Learn about SOC external memory, Scratchpads and Cache memory and Multilevel Caches.
- Learn the SOC Design approach, Design and evaluation, Applications Like Image compression etc…

**UNIT-I:**

**Introduction to the System Approach:** System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, an approach for SOC Design, System Architecture and Complexity.

**UNIT-II:**

**Processors :** Introduction , Processor Selection for SOC, Basic concepts in Processor Architecture, Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

**UNIT-III:**

**Memory Design for SOC:** Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.

**UNIT-IV:**

**Interconnect Customization and Configuration:** Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor

**UNIT-V:**

**Interconnect Configuration:** Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

**UNIT-VI:**

**Application Studies / Case Studies:** SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

**Text Books:**

1. Computer System Design System-on-Chip - Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.
2. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer

**Reference Books:**

1. ARM System on Chip Architecture – Steve Furber –2nd Ed., 2000, Addison Wesley Professional.
2. System on Chip Verification – Methodologies and Techniques – Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers.

**OUTCOMES**

After going through this course the student will be able to

- Know basics of System Architecture and Processor Architecture.
- Know different Types of Processors Like VLIW Processors, Superscalar Processors etc. and Basic concepts in Processor Micro Architecture.
- Distinguish Cache memory and Multilevel Caches, SOC external memory.
- Know the Concept of Inter Connect Architectures, SOC Standard Buses and Reconfiguration Technologies.

# LOW POWER VLSI DESIGN
## (ELECTIVE - IV)

**OBJECTIVES**

- The student will be able to understand the Fundamentals of Low Power VLSI Design.
- In this course, students can study low-Power Design Approaches, Power estimation and analysis.
- Another main object of this course is to motivate the graduate students to study and to analyze the Low-Voltage Low-Power Adders, Multipliers.
- The concepts of Low-Voltage Low-Power Memories and Future Trend and Development of DRAM.

**UNIT-I:**

**Fundamentals of Low Power VLSI Design:** Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

**UNIT-II:**

**Low-Power Design Approaches:**

**Low-Power Design through Voltage Scaling:** VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches.

**Switched Capacitance Minimization Approaches:** System Level Measures, Circuit Level Measures, Mask level Measures.

**UNIT-III:**

**Power estimation and analysis:** SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power and gate level capacitance estimation.

**UNIT-IV:**

**Low-Voltage Low-Power Adders:** Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power

Design Techniques –Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.

**UNIT-V:**

**Low-Voltage Low-Power Multipliers** Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

**UNIT-VI:**

**Low-Voltage Low-Power Memories:** Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

**Text Books:**

1. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

**Reference Books:**

1. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.
2. Practical Low Power Digital VLSI Design – Gary K. Yeap, Kluwer Academic Press, 2002.

**OUTCOMES**

After going through this course the student will be able to

- Understand the concepts of Low-Power Design Approaches.
- Design and analysis of Low-Voltage Low-Power Circuits.
- Extend the Low Power Design to Different Applications.
- Understand of Low-Voltage Low-Power Memories and Basics of DRAM.

# BIO-MEDICAL INSTRUMENTATION

## (ELECTIVE - IV)

**UNIT-I**

**Sources of Bioelectric potentials and Electrodes:** Resisting and Action Potentials, Propagation of Action Potentials, The Bioelectric Potentials. Electrodes: Electrode theory, Bio Potential Electrodes, Biochemical Transducers, introduction to bio-medical signals.

**UNIT-II**

**The Cardiovascular System:** The Heart and Cardiovascular System, The Heart, Blood Pressure, Characteristics of Blood Flow, Heart Sounds, Cardio Vascular Measurements, Electrocardiography, Measurement of Blood Pressure, Measurement of Blood Flow and Cardiac output, Plethysmography, Measurement of Heart Sounds, Event detection, PQRS & T-Waves in ECG, the first & second Heart beats, ECG rhythm analysis, the di-crotic notch in the carotid pulse detection of events and waves, analysis of exercise ECG, analysis of event related potentials, correlation analysis of EEG channels, correlation of muscular contraction.

**UNIT- III**

**Patient Care & Monitory and Measurements in Respiratory System:** The elements of Intensive Care Monitory, Diagnosis, Calibration and reparability of Patient Monitoring equipment, other instrumentation for monitoring patients, pace makers, defibrillators, the physiology of respiratory system, tests and instrumentation for mechanics of breathing, respiratory theory equipment, analysis of respiration.

**UNIT-IV**

Bio telemetry and Instrumentation for the clinical laboratory Introduction to bio telemetry, Physiological parameters adaptable to bio telemetry, the components of bio telemetry system, implantable units, applications of telemetry in patient care – The blood, tests on blood cells, chemical test, automation of chemical tests.

**UNIT-V**

**X-ray and radioisotope instrumentation and electrical safety of medical equipment:** Generation of Ionizing radiation, instrumentation for diagnostic X-rays, special techniques, instrumentation for the medical use of

radioisotopes, radiation therapy - Physiological effects of electrical current, shock Hazards from electrical equipment, Methods of accident prevention.

**UNIT-VI**

Modern Imaging Systems: Tomography, Magnetic resonance Imaging System, Ultrasonic Imaging System, Medical Thermography.

**TEXT BOOK:**

1. Biomedical Instrumentation and Measurements – C. Cromwell, F.J. Weibell, E.A.Pfeiffer – Pearson education.
2. Biomedical signal analysis – Rangaraj, M. Rangayya – Wiley Inter science – John willey & Sons Inc.

**Reference:**

1. Hand Book of Bio-Medical Instrumentation – R.S. Khandpur, (TMH)
2. Introduction to Bio-Medical Engineering – Domach, (Pearson)
3. Introduction to Bio-Medical Equipment Technology – Cart, (Pearson)

# EMI / EMC

**Pre requisites: EMTL and AWP Courses.**

**Objectives:**

- Student shall be able to understand the root causes for Electromagnetic Noise (EMI), its sources.
- Shall be able to understand the effects of EMI and the required precautions to be taken/to be discussed with his peer group.
- Shall be able to understand the different measurement techniques of EMI (for conducted and normal) and their influences in detail.
- Shall be able to understand different compatibility techniques (EMC) to reduce/suppress EMI.
- Shall be able to understand different standards being followed across the world in the fields of EMI/EMC.

**UNIT-I**:**Natural and Nuclear sources of EMI / EMC** : Introduction, Electromagnetic environment, History, Concepts, Practical experiences and concerns, frequency spectrum conservations. An overview of EMI / EMC, Natural and Nuclear sources of EMI.

**UNIT-II: EMI from apparatus, circuits and open area test sites** : Electromagnetic emissions, noise from relays and switches, non-linearities in circuits, passive inter modulation, cross talk in transmission lines, transients in power supply lines, electromagnetic interference (EMI). Open area test sites and measurements.

**UNIT-III: Radiated and conducted interference measurements**: Anechoic chamber, TEM cell, GH TEM Cell, characterization of conduction currents / voltages, conducted EM noise on power lines, conducted EMI from equipment, Immunity to conducted EMI detectors and measurements.

**UNIT-IV:ESD, Grounding, shielding, bonding and EMI filters** : Principles and types of grounding, shielding and bonding, characterization of filters, power lines filter design. ESD, Electrical fast transients / bursts, electrical surges.

**UNIT-V: Cables, connectors, components**: Introduction, EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, opto-isolators, Transient and Surge Suppression Devices.

**UNIT-VI: EMC standards- National / International** .: Introduction, Standards for EMI and EMC, MIL-Standards, IEEE/ANSI standards, CISPR/IEC standards, FCC regulations, Euro norms, British Standards, EMI/EMC standards in JAPAN, Conclusions.

**Text Books :**

1. Engineering Electromagnetic Compatibility by **Dr. V.P. Kodali, IEEE Publication**, Printed in India by ***S. Chand & Co. Ltd., New Delhi, 2000***.
2. Electromagnetic Interference and Compatibility **IMPACT series, IIT – Delhi, Modules 1 – 9**.

**References** :

**1.** Introduction to Electromagnetic Compatibility, NY, **John Wiley, 1992, by C.R. Pal.**

***Outcomes-***

At the end of this Course

- Students shall be able to distinguish effects of EMI and counter measures by EMC-techniques.
- Students shall apply the knowledge gained in selecting proper gadget/device/appliance/system, as per EMC- norms specified by regulating authorities.
- Students shall choose career in the fields of EMI/EMC as an Engineer/Researcher/Entrepreneur in India/abroad.

**IV Year – II SEMESTER**

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**Project & Seminar**