IV Year – I SEMESTER	T	P	C
	3+1	0	3

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.

****

	T	**P**	**C**
IV Year – I SEMESTER	**3+1**	**0**	**3**

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

<div style="text-align:right">

T	P	C
3+1	0	3

</div>

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.

	T	**P**	**C**
IV Year – I SEMESTER	**3+1**	**0**	**3**

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

T	P	C
3+1	0	3

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.

	T	P	C
IV Year – I SEMESTER	**3+1**	**0**	**3**

<div align="center">

Elective II

OPTICAL COMMUNICATIONS

</div>

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 Interconnect 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.

	T	**P**	**C**
IV Year – I SEMESTER	**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
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)