DEPARTMENT OF ELECTRONICS ENGINEERING
M.Tech (VLSI)
FIRST SEMESTER

VLSL531 : VLSI subsystem Design : (4-1-0-5)

Course Objectives:
1. To equip with an ability to apply knowledge of microelectronics devices & circuits.
2. An ability to design and conduct experiment related to VLSI.
3. A knowledge and understanding of founding and fabrication processes.
4. An ability to skillfully used design tools and learn different analog design based softwares.

Course Outcomes: At the end of the course, the students shall be able to
1. Understand the MOSFET basics & their fabrication & layout design rule.
2. To study the different types of current mirrors and to know the concepts of voltage and current
3. To design the single stage amplifiers using pmos and nmos driver circuits with different loads.
4. Understand high frequency concepts of single stage amplifiers and noise characteristics associated with differential amplifiers.
5. Analyze performance issue & inherent trade off involves in system design.
6. Identify the interaction between process parameter, device structure, circuit performance & system design.

Course Contents:

UNIT I :
Material Model Electrical Properties, Junction Diode. MOS transistor Operation Modes Threshold Voltage: Metal and Polysilicon Trapped Charge Implants Strong Inversion: Charge Modeling Constant Vt model: NMOS/PMOS transistors. I/V characteristics, Sign Conventions parasitic Bipolar Transistors CMOS Latch-up Analysis (D.C. and transient),

UNIT II:
Device capacitance and Charge Storage in MOS NMOS/CMOS circuit analysis, Small signal amplifier model Miller Effect. Layout / Fabrication, Diffusion / Implants / Wires, NMOS / CMOS Processes SCMOS Design Rules – special derivation self-aligned processes Resistor / Capacitor Layout, Logic Level Design, Cube Decomposition, Realization of Duals for CMOS Euler path layout, Topological Considerations. Don't Cares and Redundancy, layout Parasitic Reduction

UNIT III:
MOS Logic Families : Propagation Delay for CMOS/NMOS/PNMOS, Layout Capacitance / Resistance. Estimation; Gain effects; MOS Performance Estimation, Buffers/Capacitive Loading, Power Dissipation : Transient Optimization, Sidewall/2-d and 3-d effects: Cross-talk Fringing, Ball-park numbers for process Estimation Scaling CMOS Design Optimization: High-Speed Logic Strategies.

UNIT IV:
Interconnection. Distributed R/C cross/talk, Noise, Clocking Strategies, Sub-System Design and Partitioning Dynamic Logic, Dynamic Circuits, Stored Charge and timing. Domino Logic, Switched Capacitor and Charge Flow circuits, pass-Transistor logic (CPL).

UNIT V:
Data-Path and Memory Circuits : Static/Dynamic memories, Ancillary memory Analog Circuits. Advance topics on VLSI Design

Books :
1. Weste, "Principles of CMOS VLSI Design (2^{nd} edition)"

2. Dougles A. Pucknell and kamran Eshraghian, “Basic VLSI Systems and Circuits, Prentice Hall of India Pvt. Ltd. 1993.
3. Wayne Wolf, “Modern VLSI Design, 2nd Edition”. Prentice Hall 1998.

VLSI Subsystem Design Laboratory-I

Sr. No.	Name of the Experiment	
1.	Introduction to microwind	CO1
2.	Static Characteristics Of Inverter In Layout	CO1
3.	Design the layout of a CMOS OR gate and simulate using Microwind.	CO2
4.	Design the layout of a CMOS NOR gate and simulate using Microwind.	CO2
5.	Design the layout of a CMOS AND gate and simulate using Microwind.	CO3
6.	Design the layout of a CMOS NAND gate and simulate using Microwind.	CO3
7.	Design half adder-gate using microwind schematic and draw its layout and simulate	CO4
8.	Realize a two input EXOR gate in schematic and draw its layout and simulate	CO4
9.	To Realize a 4 X 1 MUX using transmission gates in schematic and layout and simulate.	CO5
10.	To Realize D FLIPFLOP and T FLIPFLOP in CMOS schematic and layout and simulate	CO5
11	To Realize a four bit asynchronous counter using T flipflop as a cell in schematic	CO6
12	Open Ended Experiment	CO6

ELXL531 : Embedded Systems & Controllers : (4-0-0-4)

Course Objectives:
1. The main objective of the subject lies in the understanding of microcontroller based systems and their effective implementation in application.
2. To introduce devices and other microntrollers used for embedded systems.
3. Explain programming concepts and embedded programming in C and C++.

Course Outcomes: At the end of the course, the students shall be able to
1. Acquired knowledge about Microcontroller and its need.
2. Ability to identify basic architecture of different Microcontroller 8051.
3. Foster ability to write the programming using 8051 microcontroller.
4. Foster ability to understand the internal architecture and interfacing of different peripheral devices with 8051 Microcontrollers.
5. Foster ability to understand the role of Embedded systems in industry.
6. Foster ability to understand the design concept of Embedded systems

Course Contents:

UNIT I:
Microcontrollers : Microprocessors and Micro-controllers, 8051 controller, Block Diagram &Architecture.

UNIT II:
8051 Instruction Set, Addressing modes & programming. 8051 Timers, Serial I/O, Interrupts programming,

UNIT III:

Memory Interfacing. Programming,
Real time interfacing with LED, LED display, LCD display

UNIT IV:
RISC Controller: PIC Micro-controllers – overview; features, PIC 16c6x/7x –architecture, file selection register, Memory organization, Addressing modes, Instruction set, Programming,

UNIT V:
ARM Micro-controllers – overview; features, ARM 7 –architecture, Thumb, Register Model, Addressing modes, Advance topics on embedded system

Books:
1. Steve Heath, "Embedded System Design" Butterworth Helnemann.
2. Kenneth J. Ayala "The 8051 Micro-controller – Architecture, Programming & Applications", Second Edition, Penram International & Thomson Asia.
3. John B. Peatman, "Design with PIC Micro-controllers", Low Price Edition, Pearson Education

Embedded Systems & Controllers Practical

1.	Write an ALP to generate 10 khz square wave	CO1
2.	Write an ALP to generate 10 khz freq. Using interrupts.	CO1
3.	Write an ALP to interface one microcontroller with other serial/parallel communication.	CO2
4.	Write an ALP for temperature measurment to display on intelligent LCD display.	CO2
5.	Write an ALP for temperature measurement to display on intelligent LCD display.	CO3
6.	Develop an embedded system for traffic light controller using microcontroller.	CO3
7.	Develop an embedded system for automatic motion of a car & susequet display on LCDusing microcontroller.	C04
8.	Write an ALP to add two numbers & display the result on LED	CO4
9.	Write an ALP to add two numbers & display the result on LCD	CO5
10.	Write an ALP to multiply two numbers & display the result on LED	CO6
11.	Write an ALP to multiply two numbers & display the result on LCD	CO6
12.	Open Ended Experiment	CO6

ELXL533 Advanced Digital Signal Processing 4-1-0-5

Course Objectives:
1. To introduce the student to advanced digital procesing techniques
2. To study multirate signal processing fundamentals
3. To study parametric methods for power spectrum estimation
4. To study adaptive filtering techniques and to study the applications of adaptive filtering
5. To study the analysis of speech signals.
6. To introduce the students to wavelet transforms & advanced dsp processor's

Course Outcomes: At the end of the course, the students shall be able to
1. Understand the basics of digital signal processing.
2. Understand the concept of decimation and interpolation.
3. Understand the concept of various Filter banks
4. Understand the concept of Filter Designing
5. Modeling of spectrum analysis using non-parametric as well as parametric approaches methods Power Spectral Density ,Auto Corelation Function and transfer function.
6. Understanding various techniques for application of ADSP

Course Contents:

UNIT I

Overview of digital signal processing, Multirate Signal Processing: Introduction, Sampling and signal Reconstruction, sampling rate conversion,

UNIT II

Decimation by an integer factor, interpolation by an integer factor, sampling rate conversion by rational factor, Direct form Realization of FIR systems, Linear phase and Polyphase FIR structures.

UNIT III

Multirate FIR Filter Design: Design of FIR filters for sampling rate conversion, Multistage implementation of sampling rate conversion, Applications of Interpolation and decimation in signal processing operations, subband processing, Decimated filter banks, Two channel filter banks, QMF filter banks, uniform DFT filter banks.

UNIT IV

Power Spectral Estimation: Estimation of spectra from finite duration observations of a signal, periodogram, use of DFT in power spectral estimation, Non periodic methods for power spectral estimation, Barlett, Wech & Blackman, Tukey methods, comparison of performance of Non periodic power spectral estimation methods.

UNIT V

Adaptive Filters, Introduction, Examples of Adaptive Filtering, Adaptive Equalisation, Adaptive Noise Cancelling, Echo Cancellation, Application of DSP in voice processing, Biomedical Engineering, Radar, Introduction to Wavelets.

BOOKS:

1. Oppenhiem and Schaffer, “Discrete time signal processing”, Prentice Hall
2. J. G.Proakis, D. G.Manolakis, “Digital Signal Processing principals”, Prentice Hall
3. Rabinar and Gold, “Theory and Applications of Digital Signal Processing”, Prentice Hall
4. Rabinar and Schaffer, “Digital Processing of Speech Signals”, Prentice Hall
5. Orfanadis S., ”Introduction to Digital Signal Processing”, Prentice Hall, 1989
6. S. Salivahanan, A Vallavraj, C. Gnanapriya, “ Digital Signal Processing”, 2nd Edition, McGraw Hill.

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ADSP Laboratory-I Name of Experiment

1.	To generate different discrete time signals.	CO1
2.	To perform linear convolution.	CO1
3.	To perform Co-relation. a) Auto- Co-relation b) Cross Co-relation	CO2
4.	To perform UP Sampling & DOWN Sampling of Sinusoidal & Exponential function	CO2 CO3
5.	To design and perform LPF by using window Hamming & Hanning methods	CO3
6.	To perform DFT/IDFT of sequence and plot magnitude and phase response.	CO4
7.	To perform response of notch and comb filter of having different filter	CO4
8.	To perform response of FIR filters (LPF, HPF and BPF).	CO5
9.	To design and perform LPF butter worth filter as per specification.	CO5
10.	To design and perform HPF by using Kaiser window methods.	CO6
11.	To implement program on Texas DSP TI processor (TMS320VC5416 Fixed-Point Digital Signal Processor) and CCS compiler.	CO6

12.	12.Open Ended Experiment	CO6

VLSL532 - Physics of Materials (4-0-0-4)

Course Objectives:

Course Outcome: At the end of the course, the students shall be able to

1. Qualitatively describe the bonding scheme and its general physical properties, as well as possible applications.
2. Given a type of bond, be able to describe its physical origin, as well as strength.
3. Be able to qualitatively derive a material 'Young' modulus from a potential energy curve.
4. Given the structure of a metal, be abe to describe resultantelastic properties in terms of its 1D and 2D defects.
5. Given a simple set of diffraction data, be able to index the peaks and infer the structure.
6. Be able to describe a polymer's elastic behavior above and below the glass transition.

Course Contents:

Unit I:
Nature of bonding

Unit II:
Growth of single crystals (qualitative) - crystal systems - crystal planes
and directions - expressions for interplanar distance - coordination number and packing factor for simple structures: SC, BCC, FCC and HCP.

Unit III:
Structure and significance of NaCl, ZnS, diamond and graphite.

Unit IV:
Crystal imperfections: point defects, dislocations and stacking faults

Unit V:
unit cell, Bravais space lattices - miller indices.

Text Book:

1. Solid-State Physics: An Introduction to Principles of Materials Science by Harald Ibach, Hans Lüth.
2. The Physics and Chemistry of Materials Joel I. Gersten, Frederick W. Smith
3. Solid-State Physics by **Ibach**, Harald, **Lüth**, Hans
4. Physics and Engineering of New Materials by Do Tran, **Pucci**, Annemarie, **Wandelt**, Klaus Rainer.

References Book:

1. "Physical Properties of Materials", by Mary Anne
2. Physics of New Materials by Francisco E. Fujita, R.W. Cahn, F.E. Fujita, H. Fujita, U. Gonser, J. Kanamori, K. Motizuki, R.W. Siegel, N. Sumida, K. Suzuki, N. Suzuki

ELXL539 Advanced Digital Image Processing 4-0-0-4

Course Objectives:

1. To provide the student with the fundamentals of digital image processing.
2. Give the students a taste of the applications of the theories taught in the subject. This will be achieved through the
   project and some selected lab sessions.

3. Give the students a useful skill base that would allow them to carry out further study should they be interested and to work in the field.

Course Outcomes: At the end of the course, the students shall be able to

1. To understand image formation and the role human visual system plays in perception of gray and color image data.
2. To apply image processing techniques in both the spatial and frequency (Fourier) domains.
3. To design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.
4. To conduct independent study and analysis of feature extraction techniques.
5. To understand the concepts of image registration and image fusion.
6. To analyze the constraints in image processing when dealing with 3D data sets and to apply image processing algorithms in practical applications

Course Contents:

Unit I

REVIEW OF: Digital image representation, Fundamental steps in image processing, Elements of digital image processing systems.

Unit II

Digital Image Fundamentals, Image Enhancement, Image Restoration.

Unit III

Morphological Image Processing, Image Compression, Image Segmentation.

Unit IV

Representation and Description,Recognition and Interpretation.

Text Books:

1. Oppenhiem and Schaffer, "Discrete time signal processing", Prentice Hall
2. J. G.Proakis, D. G.Manolakis, "Digital Signal Processing principals", Prentice Hall

Reference book:

1. Rafael C.Gonzalez and Richard E.Woods: Digital Image Processing Addison Wesley Publishing Company, 2010.
2. Rafael C.Gonzalez, Richard E.Woods, L Eddins: Digital Image Processing using MATLAB Pearson,2004

ELXL540 Real-Time Operating Systems (4-0-0-4)

Course Objectives:

1. Ability to apply knowledge of RTOS based design.
2. To solve problems and introduce device and buses for embedded networking.
3. Explain Real time operating system for inter & intra task communication models

Course Outcomes: At the end of the course, the students shall be able to

1. Describe the general architecture of computers.
2. Describe, contrast and compare differing structures for operating systems
3. Understand and analyse theory and implementation of: processes, resource control (concurrency etc.), physical and virtual memory, scheduling, I/O and files
4. Distinguish a real-time system from other systems
5. Evaluate the need for real-time operating system
6. Implement the real-time operating system principles

Course Contents:

Unit I : Review Of Operating Systems
Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes –Introduction to Distributed operating system – Distributed scheduling.

Unit II: Overview Of Rtos
RTOS Task and Task state - Process Synchronisation- Message queues – Mail boxes – pipes Critical section – Semaphores – Classical synchronisation problem – Deadlocks

Unit III: Real Time Models And Languages
Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

Unit V : RTOS Application Domains
RTOS for Image Processing – Embedded RTOS for voice over IP – RTOS for fault Tolerant Applications – RTOS for Control Systems.

Text Books:

1. Jane W.S. Liu: Real-Time Systems, Prentice Hall.
2. Peter Galvin and Abraham Silberschatz : Operating Systems Principle.

Reference Books:

1. Raj kamal : Embedded Systems Architecture programming and Design, Tata McGraw-Hill Publishing Company
   Limited
2. Alan C. Shaw : Real – Time Systems and software; John Wiley & Sons Inc, 2001
3. M. Singhal & N.G. Shivaratri : Advanced Concept in Operating Systems Distributed Database & Multiprocessor
   Operating System. Tata McGraw-Hill Publishing Company Limited.

VLSL533 MEMS (4-0-0-4)

Course Objectives:

1. To understand Various MEMS fabrication technologies.
2. To understand MEMS-specific design issues and constraints.
3. To understand and identify the applications of microsensors and microactuators

Course Outcomes: At the end of the course, the students shall be able to

1. Students will be able to use materials for common microcomponents and devices.
2. Students will be able to choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process.
3. Describe new applications and directions of modern engineering.
4. Describe the techniques for building microdevices in silicon, polymer, metal and other materials.
5. Critically analyze microsystems technology for technical feasibility as well as practicality.
6. Describe the limitations and current challenges in microsystems technology.

Course Contents:

Unit I:

Silicon as a material for micro electromechanical structures and devices : Mechanics and modeling of membranes, beams, comb drive and resonators. The effects of miniaturization and scaling.

Unit II:
Silicon micromachining: Photolithography, thin film deposition and doping, wet chemical etching, plasma etching and RIE, wafer bonding, surface micromachining and stiction, LIGA and DRIE for high aspect ratio.

Unit III:
Sensing and actuating mechanisms: piezo resistive, piezoelectric, capacitive and tunneling effects. Micro sensors: Pressure sensors, acceleration and angular rate sensors, flow sensors based on piezo resistive, piezoelectric and electrostatic (capacitive) effects using bulk and surface micromachining approaches. Resonant sensors.

Unit IV:
Micro actuators and their applications: Micro pumps, valves, miniature microphones and micro motors. Their design and fabrication using bulk and surface micromachining.

Unit V:
RF switches and RF MEMS. Micro fluidics and micro-reactors Integration of electronics with micro machined devices. Packaging. Bio and Optical MEMS. Other Material Systems for MEMS.

Text Books:
1. Analysis and Design Principles of MEMS Devices by Minhang Bao
2. Foundations of MEMS (2nd Edition) by Chang Liu
3. MEMS & Microsystems: Design, Manufacture, and Nanoscale Engineering by Tai-Ran Hsu , John Wiley & Sons

Reference Books:
1. MEMS & Microsystems Design & Manufacture By Hsu Tata McGraw-Hill Education,
2. Practical MEMS by Ville Kaajakari
3. Introduction to Microelectromechanical Systems Engineering By Nadim Maluf, Kirt Williams Artech House,
4. MEMS: Design and Fabrication (Google eBook) By Mohamed Gad-el-Hak CRC Press

VLSL534 Solid State Devices 4-0-0-4

Course Objectives:
1. Learn solid state physics and material science basics which will be useful for the R&D in materials science and solid state physics.
2. Understand the basic structure of semiconductors and how they conduct current
3. Describe the characteristics and biasing of a pn junction diode
4. Describe the basic structure and operation of bipolar junction transistors
5. Describe the basic structure and operation of JFETs and MOSFETs

Course Outcomes: At the end of the course, the students shall be able to
1. Understand the basic physics of electrons in solids and carriers and carrier transport in semiconductors.
2. Understand the physics and design elements of p-n junctions.
3. Understand the physics of and design elements of silicon MOSFETs.
4. Understand the nature of semiconducting materials
5. Understand the physics that influences the presence of charge carriers in a semiconductor
6. Describe the factors that influence the flow of charge in semiconductors

Course Contents:

Unit I:
Valence band and Energy band models of intrinsic and extrinsic semiconductors. Thermal equilibrium carrier concentration. Carrier transport by drift, resistivity. Excess carriers, lifetime, carrier transport by diffusion, Continuity equation.

Unit II:
Quantitative theory of PN junctions: Steady state I-V characteristics under forward bias, reverse bias and illumination.

Unit III:
Dynamic behavior under small and large signals. Qualitative theory of breakdown mechanisms.

Unit IV:
Quantitative theory of bipolar junction transistors having uniformly doped regions. Static characteristics in active and saturation regions. Emitter efficiency, transport factor, transit time, (and their calculation as functions of frequency. Charge control description.

Unit V :
Theory of Field Effect Transistors : Static characteristics of JFETs. Analysis of MOS structure. Calculation of threshold voltage. Static I-V characteristics of MOSFET's

Text Book:
1. Fundamentals of Solid State Electronics by Chih-Tang Sah.
2. Topics in Growth and Device Processing of III-V Semiconductors by S J Pearton,C R Abernathy
3. Solid State Electronic Devices (6th Edition) by Ben Streetman, Sanjay Banerjee
4. Solid State Electronic Devices by Ben G. Stretman ,Pearson Education, Limited.

Reference Books:
1. Solid State Electronic Devices by D. K. Bhattacharya, Rajnish Sharma.
2. Semiconductor Physics and Devices by Donald A. Neamen.
3. Semiconductor microdevices and materials by David H. Navon, Holt, Rinehart, and Winston
4. An Introduction to the Physics of Semiconductor Devices by David J. Roulston

VLSL535 Switching Theory & Automata 4-0-0-4

Course Objectives:
1. To provide adequate knowledge of Switching theory & automata.
2. Students must show mastery in the three basic areas of mathematics: analysis, algebra, and topology /geometry on a basic level in lower division courses.
3. To understand design of combinational logic.
4. A theory concerned with models used to simulate objects and processes such as computers, digital circuits, nervous systems, cellular growth and reproduction with different techniques & algorithms.

Course Outcomes: At the end of the course, the students shall be able to
1. Acquire knowledge about switching theory and algebra.
2. Ability to learn and design sequential circuits.
3. Acquire knowledge and ability to analyze threshold gates sand their synthesis.
4. Foster ability to use PLDs and PLAs.
5. Acquired knowledge about and ability to design ASM and FSM.
6. Learn about various fault tolerance and disgnosis techniques.

Course Contents:

Unit I:

Shannon's expansion theorem, Consensus theorem, Octal designation, Run measure,
INHIBIT/INCLUSION/AOI/Driver/ Buffer gates, gate expander, Reed Muller expansion, Synthesis of multiple output combinational logic circuits by product map method, Design of static hazard free and dynamic hazard free logic circuits.

Unit II:
Linear seperability. Unateness, Physical implementation, Dual comparability, Reduced functions, various theorems In threshold logic, Synthesis of single gate and multigate threshold Network. Elementary symmetric functions, partially symmetric and totally symmetric functions, Mc-Cluskey decomposition method. Unity ratio symmetric ratio functions, Synthesis of symmetric function by contact networks.

Unit III:
Mealy Moore State Tables and Systems. State tables from Word Descriptions, Special Methods for Multi Condition
Sequence Detectors, Analysis of Finite State Machines Minimization of sequential Machines, State Equivalence and State Table Reduction, machine Equivalence, incompletely Specified machines, Special Heuristic State Table Reduction.

Unit IV:
State Assignment using partitions of States, Reduction of State variable and Output Dependencies. Input Independence and Autonomous Clocks, Information Flow in Sequential machines, partition pairs, Mm Pairs, Decomposition into Separate Machines, State Identification and Fault Detection Experiments.

Unit V:
Memory Span, Input –Output Memory, Output Memory, Input Memory, Information Loss less Machines, Synchronaizable and Uniquely Decipherable Codes,Advanced topics in the subject.

Text Books:

1. Kohavi, "Switching and Finite Automata Theory". (2nd edition), McGraw Hill. 1986
2. Modern switching theory by S.C.lee

Reference Books:

1. William I Flecher, "Engineering approach to Digital Design", Prentice Hall, 1996

VLSL536 Reconfigurable Computing 4-0-0-4

Course Objectives:
1. To understand the concepts of architecture reconfigurability, programmable logic devices and optimization of the Reconfigurable computer architecture to the task algorithm and data structure.
2. To understand the basics of the Complex Programmable Logic Devices (CPLD) and Field Programmable Gate Array (FPGA) organization and Reconfigurable computer architectures based on these devices.
3. To understand and identify Reconfigurable Computing Systems (RCS) application in DSP, Video / Image Processing and Supercomputing applications

Course Outcomes: At the end of the course, the students shall be able to
1. Able to understand the state-of-the-art in reconfigurable computing both from a hardware and software perspective.
2. Able to understand both how to architect reconfigurable systems and how to apply them to solving challenging computational problems.
3. Able to make significant contribution in the research on reconfigurable computing.
4. Able to identify mapping algorithms into architectures.
5. Able to summarize various delays in combinational circuit and its optimization methods..
6. construct combinational and sequential circuits of medium complexity, that is based on VLSIs,and programmable logic devices.

Course Contents:

Unit I:
Introduction, Objectives, Expectations, Logistics.

Unit II:
Field Programmable Gate Arrays I Field Programmable Gate Arrays II FPGA Placement FPGA Routing Network Virtualization with FPGAs.

Unit III:
On-chip Monitoring Infrastructures Dynamically Reconfigurable Adaptive Viterbi Decoder Multi-FPGA Partitioning Logic Emulation Reconfigurable Computing Applications High Level Compilation.

Unit IV:
VLSI/FPGA Design for Wireless Communication Systems Reconfigurable Coprocessors.

Unit V:
Power Reduction Techniques for FPGAs Reconfigurable Memory Security Hardware Monitors to Protect Network Processors General Purpose Graphics Processor for FPGAs

Text Books:

1. Reconfigurable Computing: The Theory and Practice of FPGA-Based Computation Scott Hauck, André DeHon Reconfigurable Computing
2. **Cardoso**, Joao, **Hübner**, Michael (Eds.)
3. Dynamic Reconfigurable Network-on-Chip Design: Innovations for Computational Processing and
4. Communication Jih-Sheng Shen, Pao-Ann Hsiung Reconfigurable Computing **Gokhale**, Maya B., **Graham**, Paul S.

ELXL538 Data Communication 4-0-0-4

Course Objectives:
1. To Study the various Data network & Protocols.
2. To study the various data communication network.
3. To study the different protocols in data communication network.
4. To study the different layers used in data communication.

Course Outcomes: At the end of the course, the students shall be able to
1. Understand and explain Data Communications System and its components
2. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
3. Identify the different types of network devices and their functions within a network.
4. To introduce basic concepts of Data communication with different models.
5. Enumerate the physical layer, DLL , NL, TL and AL, its explanation of the function(s) of each layer.
6. To introduce about the switching concept and its different types.

Course Contents:

Unit I:
Review of data communication techniques, Data transmission, Line coding, Data Switching, Circuit switching, Massage & packet switching, Network model, ISO-OSI model, primitives and services, Elements of queuing theory,

Unit II:

Data link control – simplex, pipelined and sliding window protocols. P73 simplex performance analysis, X25 data link layer, random access techniques, pure, slotted and finite population ALOHAS, stability in ALOHAS,

Unit III:
Routing and congestion control – static, adaptive centralized and distributed routing procedures, congestion control,

Unit IV:
Local area networks – LAN topologies and protocols IEEE 802 protocols, implementation & performance issues, high speed LANs, transport layer, quality of service, transport classes,

Unit V:
Design issues, buffer managements, synchronization, session & presentation layer, synchronization issues, formatting, data compression, data security.

Text Books:
1. Schwartz: Computer Communication Networks Design (McGraw Hill)
2. Tenenbaum: Computer Networks (PHI)
3. Bertsekas & Gallager: Data Networks (PHI)

Reference Books:
1. James F. Kurose and Keith W. Ross, “Computer Networking: A Top-Down Approach Featuring the Internet”, Pearson Education, 2003.
2. Larry L.Peterson and Peter S. Davie, “Computer Networks”, Harcourt Asia Pvt. Ltd., Second Edition
3. William Stallings, “Data and Computer Communication”, Sixth Edition, Pearson Education, 2000.

SECOND SEMESTER

VLSL537 Analog VLSI Design 4-0-0-4

Course Objectives:
1. Ability to apply knowledge of VLSI circuits.
2. Ability to solve problems related to analog domain.

Course Outcomes: At the end of the course, the students shall be able to
1. How to design VLSI chip layouts to account for process corners and fabrication process variations.
2. How to design chip layouts for the latest, deep submicron processes that include extremely short-channel effects, extreme transistor leakage, chemical mechanical polishing, and antenna rules.
3. How to characterize digital circuits for crosstalk noise in the layouts
4. Design of efficient analog circuits
5. Ability to use design tools for analog domain.
6. Able to work on mixed signal issues.

Course Contents:

Unit I:
Device modeling and simulation Modeling, MOS Models Diode model, Bipolar modes BSIM Spice models, Circuit simulations using Spice. Basic Building Blocks: Switches. Current sources and sinks. Current mirrors. Voltage and current references.

Unit II:
Amplifiers: MOS Inverting amplifier, Cascade amplifiers. Feedback amplifiers
Differential amplifiers. Frequency response, noise performance in Diff amplifiers, Output amplifiers.

Unit III:
CMOS Two stage OPAMP Design, Cascade OPAMPs, Simulation and Measurement of OPAMPs, Comparators. **Analog signal processing, CMOS Digital to analog converters, Scaling and serial, cyclic.**

Unit IV:
Analog to digital converters Serial, SAR, Parallel, Pipelined, sigma-delta converters,

Unit V:
Mixed signal Layout issues.Continuous time filters, Switched capacitor filters, Modulator and multipliers, PLL. Advance topics on Analog VLSI

Text Books :
1. R.L. Geiger, P.E. Allen, “VLSI Design techniques for Analog and digital Circuits”, McGraw Hill
2. J. Baker, D.E. Boyce. “CMOS Circuit Design, Layout and simulation”, IEEE press.

ANALOG VLSI DESIGN LAB

	LIST OF EXPERIMENTS	
1.	Study of the Cadence design system tool.	CO1
2.	Layout Design using LAY techniques.	CO1
3.	MOS Device Characterization and parametric (PAR) analysis.	CO2
4.	Current Mirrors: Simple, cascode, feedback and low-voltage.	CO2
5.	Inverting Amplifiers: Current Mirror Load, Digital CMOS, PMOS with self biased	CO3
	load and self biased CMOS.	CO3
6.	Differential Amplifiers: Simple and cascode current mirrors.	CO4

7.	Operational Trans conductance Amplifiers (OTA): Symmetrical OTA.	CO4
8.	Operational amplifiers (OP): Three stage OP-AMP.	CO5
9.	The parametric (PAR) analysis Analog System: Continuous low pass filter.	CO5
10.	Switched Capacitor Integrators: Use of transmission gates, capacitors and OP-AMP.	CO6
11.	Open Ended Experiment	CO6

VLSL538 Modeling of Digital Systems 4-0-0-4

Course Objectives:

1. To understand the language based Digital System Modeling.
2. Understanding the design flow to VHDL language.
3. It is expected that students should able to model digital systems and implement using CPLD and FPGA devices with less hardware consumption.

Course Outcomes: At the end of the course, the students shall be able to

1. To understand digital systems modeling using VHDL.
2. Write correct synthesizable System VHDL models along with test benches.
3. Design digital systems that are reconfigurable for testing and test it on FPGA
4. To analyze synchronous and asynchronous sequential circuits
5. To estimate the performance of digital systems
6. To know about timing analysis of memory and PLD

Course Contents:

UNIT I:

Programming Technologies – ROMs & EPROMs PLA . PAL gate Arrays Programmable gate arrays and applications, Antifuse FPGA, Synthesis methods for FPGA.

Hardware Description Language. Design entities, architecture Bodies, Block Statements, processes data types. Operators. Classes of Objects, Attributes, Functions and Procedures, Packages Control Statements.

UNIT II:

Behaviour modeling.- Process Statement, Assertion Statement, Sequential wait Statement, Formatted ASCII I/O Operations Structural Modeling ; parts Library wiring of Primitives. Wiring of Iterative networks. Modeling a test bench.

UNIT III:

Chip Level Modeling : Chip level modeling structures modeling delay, process model graphs, Functionally partitioned models, Timing Assertion, Setup & Hold time for clocked devices, Design rule checksSystem Modeling : Modeling system interconnection, general model for signal interconnection, Multiplexing of signals. Multiple valued logic.

UNIT IV:

Processor model. RAM model. UART model, Parallel I/O Ports, Interrupt controllerSimulation with the physical model, simulation, writing test bench, converting real and interconnection, Multiplexing of signals. Multiple valued logic.

UNIT V:

Processor model. RAM model. UART model, Parallel I/O Ports, Interrupt controller.Simulation with the physical model, simulation, writing test bench, converting real and integer to time. Dumping results into text file, reading vectors from text file, test bench example. Advance topics on Digital System Modelling

Books:

1. Navabi Z, “VHDL Analysis and Modeling of Digital Systems”. Prentice Hall, 1993
2. J. Bhasker “VHDL Primer”, Pearson Education, 2000
3. Armstrong & Grey. “VHDL Design. Representation and Synthesis”, PHPTR, 2000
4. James R. Armstrong, “Chip Level Modeling with VHDL”, Prentice hall, 1989

ELXL535 Optimization Techniques 3-1-0-4

Course Objectives:

1. Introduce methods of optimization to engineering students, including linear programming, nonlinear programming, and heuristic methods.
2. To study a balance between theory, numerical computation, problem setup for solution by optimization software, and applications to engineering systems.
3. To study General optimization algorithm; necessary and sufficient conditions for optimality

Course Outcomes: At the end of the course, the students shall be able to

1. Students are able to identify real-world objectives and constraints based on actual problem descriptions.
2. Students are able to create mathematical optimization models.
3. Students are able to make recommendations based on solutions, analyses, and limitations of models.
4. Students are able to work on parallel system dynamics
5. Students are able to work on fundamentals of queuing system
6. Students are able to work on related area of optimization techniques

Course Contents:

Unit I:
Convex sets and functions, constrained optimization methods: Introduction, Kuhn-Tucker conditions, convex optimization

Unit II:
Lagrange multipliers, Non-linear programming: One-dimensional minimization method, seach method, unconstrained and constrained optimization theory and practices.

Unit III:
Reliability: Basic concepts, conditional failure rate function, Failure time distributions, Certain life models, Reliability of a system in terms of the reliability of it's components, series system,

Unit IV:
Parallel system.Dynamic Programming: Multistage decision problems, computation procedure and case studies.

Unit V:
Fundamentals of queuing system, Poisson process, the birth and death process, special queuing methods.

Books:

1. S.S Rao.. Optimization: Theory and Practices, New Age Int. (P) Ltd. Publishers, New Delhi.
2. Chong, E.K.P.and Zak, S. H.. An Introduction to Optimization, John Wiley & Sons, N.Y.
3. Peressimi A.L., Sullivan F.E., Vhl, J.J..Mathematics of Non-linear Programming, Springer – Verlag.

Pool of Electives (Students can select any 02 courses for Elective-III & IV)

VLSL539 -Low Power VLSI Design 4-0-0-4

Course Objectives:

1. To understand the concept of VLSI circuit of low power operation

2. To design various circuits for optimize power
3. To understand case study of low power design

Course Outcomes: At the end of the course, the students shall be able to
1. Recognise advanced issues in VLSI systems, specific to the deep-submicron silicon technologies;
2. classify the mechanisms of power dissipation in CMOS integrated circuits;
3. Students able to understand digital CMOS design styles.
4. model power dissipation and use optimisation methods on various levels;
5. apply in practice technology-level, circuit-level, and system-level power optimisation techniques.
6. To design chips used for battery-powered systems and high-performance circuits

Course Contents:

Unit I: Low Power CMOS VLSI Design (8 Hrs)
Introduction, Sources of power dissipation, Designing for low power, Simulation, Low Power COMOS VLSI Design

Unit II: Physics of power dissipation in CMOS FET devices (8 Hrs)
Power Dissipation in CMOS, Short Circuit & Dynamic power dissipation, Load Capacitances Low power VLSI Design Limits, Architecture and Systems Advanced Techniques, Special Techniques. Power dissipation in MOSFET devices.

Unit III: Power Estimation (8 Hrs)
Power Analysis- Probabilistic Power Analysis, Signal Probability Calculation, Probabilistic technique, Statistical technique, Glitches, Estimation of Power. Power Estimation at circuit level & Higher level.

Unit IV: Low Power Static RAM Architecture (8 Hrs)
Low Power Static RAM Architectures, MOS static RAM memory cell, Reducing voltage swing on bit lines, Reducing power in write driver circuits and sense amplifier circuit, Methods for achieving low core voltages from a single
Supply.

Unit V: Energy Recovery Technique and software Design for low power (8 Hrs)
Energy Recovery Circuit design, Designs with partially reversible logic, Supply clock generation, Sources of
Software power dissipation, Software power estimation, software power optimization.
Advanced topics on the subject.

Text Books:
1. Kaushik Roy, Sharat Prasad, “Low Power CMOS-VLSI Circuit Design”, 2000

Reference Books:
Gary Yeap “Practical Low Power Digital VLSI Design”, 1997.

VLSL540 - Nano Materials 4-0-0-4

Course Objectives:
1. To understand the behavior of nanomaterials , quantum phenomena and the limitations of basic physical laws that are important at the nanometer length scale are introduced and developed.
2. Study particular, properties that exhibit size effects (including electronic, magnetic, photonic, and mechanical) at the nanometer length scale will be presented so that nanomaterials becoming increasing relevant to modern technologies can be better understood.
3. The course will cover the environmental, health and ethical implications of nanomaterials in society.

Course Outcomes: At the end of the course, the students shall be able to

1. Explain the importance of reduction in materials dimensionality, and its relationship with materials properties.
2. demonstrate a systematic knowledge of the range and breadth of application of nanomaterials
3. review critically the potential impact, in all classes of materials, of the control of nanostructure
4. describe the methods for the chemical and nanostructural characterisation of such materials and select appropriate techniques for a range of situations
5. outline the nanotechnology production routes currently available
6. identify possible opportunities for nanomaterials in product development and enhancement

Course Contents:

Unit I: General properties of Nano materials – mechanical properties;

Unit II: Fullerenes and CNT's – Synthesis, physical properties;

Unit III: Investigation and manipulating materials in the Nanoscale – SAMs and clusters.

Unit IV: Semi conducting Quantum Dots.

Unit V: Nanobiology- Nanosensors – Nanomedicines.

Text books:
1. Nanomedical Device and Systems Design: Challenges, Possibilities, Visions Author: **Frank J. Boehm**
2. Nanostructures, Nanomaterials, and Nanotechnologies to Nanoindustry Vladimir I. Kodolov, Gennady Efremovich Zaikov, A. K. Haghi
3. Advanced Nanomaterials: Synthesis, Properties, and Applications Sabu Thomas, Nandakumar Kalarikkal, A. Manuel Stephan, B. Raneesh

Reference Books:
1. Carbon-based Nanomaterials and Hybrids: Synthesis, Properties, and Commercial Applications Hans J. Fecht, Kai Brühne
2. Nanoscience and Nanoengineering: Advances and Applications Ajit D. Kelkar, Daniel J.C. Herr, James G. Ryan

VLSL541 Networks On Chip (4-0-04)

Course Objectives:
1. To learn the basic concepts of NoC design by studying the topologies, router design and MPSoC styles,
2. To learn sample routing algorithms on a NoC with deadlock and livelock avoidance,
3. To understand the role of system-level design and performance metrics in choosing a NoC design,
4. To understand the relationship between semiconductor technology, computer architecture and computer networking in the design of the communication network for a MPSoC or a many-core design.

Course Contents:

Unit I:
Communication infrastructure between the many cores of a multi-processor system on-a-chip (MPSoC).

Unit II:

Quad-core, eight-core, eighty-core processors that target exa-scale computing or multi-core systems that target high-performance mobile computing.

Unit III:
Systematic understanding, design and analysis of NoCs will be covered.

Unit IV:
In particular, the focus will be on topics that include Topology design,Routing algorithms,Router design.

Unit V:
Emerging NoC paradigms,System-level performance metrics.

Course Outcomes: At the end of the course, the students shall be able to
1. To learn the basic concepts of NoC design by studying the topologies, router design and MPSoC styles,
2. To learn sample routing algorithms on a NoC with deadlock and livelock avoidance,
3. To understand the role of system-level design and performance metrics in choosing a NoC design
4. To gain knowledge on NOC design
5. Understand about IP cores and application specific design
6. Understand about communication and networking of soc

Text Books:
1. N. Enright Jerger and L-S. Peh, On-Chip Networks, Synthesis
2. Lectures on Computer Architecture, Morgan & Claypool, 2009,

Reference Books:
1. A Jantsch and H. Tenhunen, Networks on Chip, Kluwer Academic Publishers, 2003.
2. W. J. Dally, Principles and Practices of Interconnection Networks, Morgan Kaufmann, 2004.

VLSL542 - Mixed Signal Design 4-0-0-4

Course Objectives:
1. This Mixed Signal processing course provides comprehensive techniques on the essential concepts of Mixed Signal Testing. This information is designed to elevate the baseline understanding and capabilities of product/test engineers.
2. This subject introduces digital test and linear test engineers to the mixed signal world by teaching the basics of analog and mixed signal test methods. Sampling Theory, Frequency Domain Testing, and Digital Signal Processing.
3. The course applies these fundamental concepts to different test methods and data validation for mixed signal parameters together with debugging, noise reduction and device interface techniques.

Course Outcomes: At the end of the course, the students shall be able to
1. Design noise-shaping data converters given a set of requirements such as bandwidth, clock speed, and signal-to-noise ratio.
2. Design, simulate, and implement the digital interpolation and decimation filters used in noise-shaping data converters.
3. Design, simulate, and implement the analog filters used for anti-aliasing and reconstruction in a data conversion system.
4. Discuss the limitations of op-amps and comparators used in noise-shaping data converters.
5. Simulate noise-shaping data converting circuits and systems and the filtering used.
6. Design a high-speed noise-shaping converter using a cascaded modulator or the K-Delta-1-Sigma topology.

Course Contents:

Unit I:
CMOS comparators, switched capacitor circuits and filters.

Unit II:
Dynamics of PLL, phase detector, loop filters, charge pump PLLs.

Unit III:
Data converter fundamentals, specifications, Nyquist rate D/A and A/D converters-Over sampling converters, noise shaping modulators, multibit delta sigma converters

Text Books:
1. CMOS: Mixed-Signal Circuit Design, Second Edition R. Jacob Baker
2. CMOS Analog Circuit Design , by Allen and Holberg
3. Design of Analog CMOS Integrated Circuits, by Razavi.
4. Analysis and Design of Analog Integrated Circuits, by Gray, Hurst, Lewis, and Meyer.

Reference Books:
1. CMOS: Mixed-Signal Circuit Design**,** by Baker
2. Analog VLSI: Signal and Information Processing**,** by Ismail and Fiez.
3. Switched-currents: an analogue technique for digital technology**,** by Toumazou, Hughes, and Battersby (eds)

VLSL543 - VLSI Signal Processing 4-0-0-4

Course Objectives:
1. Course equips the student to understand the concepts of VLSI Signal processing.
2. To understand the concept of pipelining & parallel processing.
3. To reduce the chip area using folding, unfolding techniques and different algorithms.

Course Outcomes: At the end of the course, the students shall be able to
1. Recognize advance issue and classify the mechanism of power dissipation in VLSI System and specific deep submicron Technology.
2. To understand the concept of pipelining and parallel processing.
3. Model Power dissipation, use optimization techniques for technology level, Circuit level, and System level designs.
4. To be able to design architectures for DSP algorithms.
5. To be able to optimize design in terms of area, speed and power.
6. To be able to incorporate pipeline based architectures in the design.

Course Contents:

Unit I: (8 Hrs)
Pipelining and Parallel Processing: introduction, pipelining of FIR Digital filters Parallel processing. Pipelining and parallel processing for low power.

Unit II: (8 Hrs)
Retiming: Introduction, Definition and properties, Solving system of inequalities, retiming techniques.

Unit III: (8 Hrs)

Unfolding: Introduction An algorithms for unfolding, Properties of unfolding, Critical path, unfolding and retiming, Application of unfolding.
Folding: Introduction Folding Transformation, Register Minimization Techniques, Register minimization in folded architectures Folding if Multirate systems

Unit IV: (8 Hrs)
Systolic Architecture Design: Introduction, Systolic Array Design Methodology, FIR systolic Arrays, Selection of
scheduling vector, Matrix Multiplication and 2D systolic array Design, Systolic design for space representations
containing Delays.

Unit V: (8 Hrs)
Fast Convolution: Introduction, Cook, Toom algorithm, Winogard algorithm, iterated convolution, Cyclic Convolution,Design of Fast Convolution Algorithm by Inspection.

Advance topics on VLSI Signal Processing and Algorithm

Text Books:
1. Keshab K. Parhi. "VLSI Digital Signal Processing Systems" Wiley-Inter Sciences. 1999
2. Mohammed Ismail, Terri, Fiez, "Analog VLSI signal and information processing 1994. McGraw Hill.

Reference Books:
1. Keshab. Parthi, VLSI Digital signal processing system Design and implementation Wiley-Inter science, 1999.
2. Kung. S.Y., H.J. While house T.Kailath "VLSI and Modern signal processing, prentice hall. 1985.

ELXL548 DSP Processors & Architectures 4-0-0-4

Course Objectives:
1. To impart Digital Signal Processor basics
2. Third generation DSP Architecture and programming skills
3. Advanced DSP architectures and some applications.

Course Outcomes: At the end of the course, the students shall be able to
1. Acquired knowledge about Fundamentals of DSP Processors.
2. Ability to understand the DSP Architecture.
3. Foster ability to understand memory architecture for DSP.
4. Foster ability to understand the need of different types of instructions for DSP.
5. Foster ability to understand architecture of different types of DSP processor 8 bit and 16 bit.
6. Foster ability to design and implementation of different applications using DSP on FPGA

Course Contents:

Unit I:
An overview of DSP concepts-Linear system theory, DFT, FFT, realization of digital filters. Typical DSP algorithms, DSP applications.

Unit II:
Data flow graph representation of DSP algorithm. Loop bound and iteration bound Retiming and its applications.

Unit III:
Algorithms for fast convolution. Algorithmic strength reduction in filters and transforms. DCT and inverse DCT. Parallel FIR filters. Pipelining of FIR filters. Parallel processing. Pipelining and parallel processing for low power.

Unit IV:
Pipeline interleaving in digital filters. Pipelining and parallel processing for IIR filters.Low power IIR filter design using pipelining and parallel processing, Pipelined adaptive digital filters.

Unit V:
Round off noise and its computation. State variable description of digital filters, Round off noise computation using state variable description. Scaling using slow-down, retiming and pipelining.

Text Books:

1. Oppenhiem and Schaffer, “Discrete time signal processing”, Prentice Hall.
2. J. G.Proakis, D. G.Manolakis, “Digital Signal Processing principals”, Prentice Hall

Reference Books:

1. Rabinar and Gold, “Theory and Applications of Digital Signal Processing”, Prentice Hall
2. Rabinar and Schaffer, “Digital Processing of Speech Signals”, Prentice Hall
3. Orfanadis S., ”Introduction to Digital Signal Processing”, Prentice Hall, 1989
4. S. Salivahanan, A Vallavraj, C. Gnanapriya, “Digital Signal Processing”, 2nd Edition, McGraw Hill

VLSL544 : High Speed Devices and Circuits : 4-0-0-4

Course Objectives:

1. To obtain an understanding of a variety of signaling schemes and system-level trade-offs in high-speed links.
2. To obtain the ability to design and simulate both analog and digital circuits for high-speed links using Cadence and MATLAB tools.
3. To understand different link standards such as PCI Express, SATA, MIPI-MPHY etc.
4. To obtain an overview of the literature in high-speed I/O links.

Course Outcomes: At the end of the course, the students shall be able to

1. Understand the properties and fundamental limitations of high speed electronic systems in terms of the underlying physical principles.
2. Quantitatively model and analyse high speed electronic systems and interconnects in both the digital and analogue domain
3. Simulate the behaviour of high speed electronic systems using software tools
4. Identify different MOS devices for the specific application.
5. Fabrication of different MOS devices corresponding to the requirements.
6. Integrate different MOS devices.

Course Contents:

Unit I:
Introduction to Basic Concepts ,Requirements of High Speed Devices, Circuits & Mat

Unit II:
Crystal Structures in GaAs GaAs and InP Devices for Microelectronics Ohmic Contacts on Semiconductors Fermi Level Pinning & Schottky Barrier Diodes Schottky Barrier Diode

Unit III:
Causes of Non-Idealities-Schottky Barrier Diodes MESFET Operation & I-V Characteristics. Unit IV: Hetero Junctions -Hetero Junctions&HEMT(Contd) High Electron Mobility Transistor HEMT-off Voltage HEMT 1-V Characteristics and Transconductance

Unit IV:
Indium Phosphide Based HEMT -Pseudomorphic HEMT

Text Books:

1. High-Speed Electronics and Optoelectronics: Devices and Circuits Sheila Prasad, Hermann Schumacher, Anand Gopinath
2. GaAs High-Speed Devices: Physics, Technology, and Circuit Applications By C. Y. Chang
3. High-speed digital circuits Masakazu Shoji Addison-Wesley Pub. Co

Reference Books:

1. High Speed Digital Design: A Handbook of Black Magic Howard Johnson (Author), Martin Graham (Author)
2. High Speed CMOS Design Styles Kerry Bernstein
3. Design of High-speed Communication Circuits Ramesh Harjani World Scientific

VLSL545 - CMOS RF Circuit Design 4-0-0-4

Course Objectives:

1. Introduce the theory and concept of radio frequency integrated system.
2. To analyze the performance parameters of radio frequency circuits and identify design trade-off of radio frequency communication systems.
3. Students will perform practical design and simulation exercises using the electronic design automation tools to enhance their understanding of the design problems encountered in CMOS RF integrated circuits.

Course Outcomes: At the end of the course, the students shall be able to

1. Understanding of the design and analysis of radio frequency integrated circuits and systems (RFICs) for communications
2. Understanding the enabling integrated circuit technology and devices
3. An ability to design analog electronic circuits for telecommunications applications.
4. An ability to design the basic building blocks of telecommunication systems.
5. An ability to analyze the performance of telecommunication circuits under real-world environments, i.e., in the presence of noise and nonlinear device characteristics.
6. An ability to appreciate the problems associated with the design of telecommunication circuits.

Course Contents:

Unit I: Characteristics of passive IC components at RF frequencies.

Unit II: Two port noise theory, passive impedance transformation.

Unit III: High frequency amplifier design, Low noise amplifiers.

Unit IV: Mixers, RF power amplifiers.

Unit V: Oscillators and synthesizers, phase noise considerations

Text Books:

1. The Design of CMOS Radio-Frequency Integrated Circuits, Second Edition Thomas H. Lee
2. Design of CMOS Rf Integrated Circuits and Systems Manh Anh Do, Chirn Chye Boon, Kiat Seng Yeo
3. Design of CMOS RF Integrated Circuits and Systems
4. Kiat Seng Yeo, Manh Anh Do, Chirn Chye Boon World Scientific,

Reference Books:

1. The Design of CMOS Radio-Frequency Integrated Circuits Thomas H. Lee Cambridge University Press CMOS RFIC design principles
2. Robert Caverly Artech House,

THIRD SEMESTER

Pool of Electives (Students can select any 02 courses for Elective-V & VI)

VLSL546 : VERILOG HDL : 4-0-0-4

Course Objectives
1. To understand the language based Digital System Modeling.
2. Understanding the design flow to Verilog language.
3. It is expected that students should able to model digital system and implement using CPLD and FPGA devices.

Course Outcomes: At the end of the course, the students shall be able to
1. To understand digital systems modeling using Verilog.
2. will be able to design synchronous and asynchronous sequential circuits.
3. will be able to use programmable logic devices for designing of circuits
4. will perform fault diagnosis and testing in digital circuit.
5. Write correct synthesizable System Verilog models along with test benches.
6. Design digital systems that are reconfigurable for testing and test it on FPGA

Course Contents:

Unit I:
Explain the structure and fundamental components of digital systems. The Verilog Hardware Description Language (HDL) Introduction to Verilog HDLs Verilog system design

Unit II:
Describe the fundamental architecture of digital functional units such as data converters, message generators, ALUs, and memory. Module testing, Behavior modeling, Tasks and functions ,Verilog structure, syntax and semantics

Unit III:
Execute digital module designs from written functional and systems specifications. Gate level Modeling, Dataflow modeling,Reset function design, Specification and design of digital sequential modules. Introduction to sequential modules

Unit IV:
Analyze and synthesize design interfaces between two or more digital modules, using various handshaking and responsive pair protocols.

Unit V:
Use the Verilog design, synthesize, test and modeling tools. (6) Discuss cost/performance trade offs of different bus and interface architectures.

Text Books :

1. Palmer J.E. Perlman D.E., "Introduction to digital System". McGraw Hill
2. Nelson, Nagale, Carroil, Irwin, "Digital Logic Circuit Analysis and Design", Prentice Hall
3. John Oldfield, Richard Dorf. "Field Programmable Gate Array: Re configurable logic for rapid prototyping and implementation of Digiatl System", John Wiley

Reference Books:

1. "Programmable Logic Devices Data book and Design Guide". National Semiconductors
2. Pradnan D.K., "Fault-Tolerant-Theory and Techniques. Vol and II, Prentice Hall
3. J.Bhasker "A Verilog HDL Prime 2e". BS Publications. 2001

VLSL547 VLSI Testing & Verification 4-0-0-4

Course Objectives

1. The course equips the student to understand the concepts of VLSI circuits testing.
2. It helps the student to use various design tools.

Course Outcomes: At the end of the course, the students shall be able to

1. Recognize Faults and classify different fault detection in VLSI Systems design at various levels.
2. Design, develop algorithms for analysis of faults and test methodology.
3. acquire knowledge about fault odeling and collapsing.
4. learn about various combinational ATPG.
5. understand sequential test patten generation.
6. use various verification techniques.

Course Contents:

Unit I

Faults and their manifestations. Fault models.

Unit II

Combinational logic and fault simulation.Test generation basics. Structural and non-structural test generation techniques. Combinational ATPG.

Unit III

Current sensing based testing.Classification of sequential ATPG methods. Fault collapsing and simulation Test generation for synchronous and asynchronous circuits.

Unit IV

Test compaction. Universal test. Pseudo-exhaustive and iterative logic array testing. Clocking schemes for delay fault testing. Testability classifications for path delay faults.

Unit V

Test generation and fault simulation for path and gate delay faults.Design for testability: Scan design, use of scan chains, boundary scan. Built-in self test. Synthesis for testability.

Text Books:

1. Jane W.S. Liu, Real-Time Systems, Prentice Hall.
2. Operating Systems Principle By Peter Galvin and Abraham Silberschatz.

Reference Books:

1. Raj kamal: Embedded Systems Architecture programming and Design, Tata McGraw-Hill Publishing Company Limited
2. Alan C. Shaw : Real – Time Systems and software by; John Wiley & Sons Inc, 2001
3. M. Singhal & N.G. Shivaratri : Advanced Concept in Operating Systems Distributed Database & Multiprocessor Operating Systems. Tata McGraw-Hill Publishing Company Limited.**4.** I & II, Prentice Hall, 1986

VLSL548 : ASIC DESIGN : 4-0-0-4

Course Objectives:

1. To prepare the student to be an entry level industrial standard cell ASIC or FPGA designer.
2. To give the student an understanding of issues and tools related to ASIC/FPGA design.

3. Prepare the student for implementation, including timing, performance and power optimization, verification and manufacturing test.

Course Outcomes: At the end of the course, the students shall be able to

1. Students will be able to design and synthesize a complex digital functional block, containing over 1,000 gates, using Verilog HDL and Synopsys Design Compiler.
2. Students will demonstrate an understanding of how to optimize the performance, area, and power of a complex digital functional block, and the tradeoffs between these.
3. Students will demonstrate an understanding of issues involved in ASIC design, including technology choice, design management, tool-flow, verification, debug and test, as well as the impact of technology scaling on ASIC design.
4. To learn the advanced concepts of modern VLSI circuit and system design, including differences between ASICs and FPGAs, standard cells, cell libraries, IPs etc. •
5. To have experience with a logic synthesis tool for mapping RTL onto a cell library,
6. To understand the back-end physical design flow, including floorplanning, placement, CTS and routing.

Course Contents:

Unit I:
Types of ASICs. ASIC design flow. Programmable ASICs. Antifuse, SRAM, EPROM, EEPROM based ASICs. Programmable ASIC logic cells and I/O cells. Programmable interconnects.

Unit II:
An overview of advanced FPGAs and programmable SOCs : Architecture and configuration of Spartan II and Virtex II FPGAs . Apex and Cyclone FPGAs. Virtex II PRO kits and Nios kits. OMAP. ASIC physical design issues. system partitioning, interconnect delay models and measurement of delay.

Unit III:
ASIC floor planning, placement and routing. Design issues in SOC. Design methodologies. Processes and flows. Embedded software development for SOC. Techniques for SOC testing. Configurable SOC. Hardware/software codesign.

Unit IV:
High performance algorithms for ASICS/ SOCS. SOC case studies- DAA and computation of FFT and DCT. High performance filters using delta-sigma modulators.

Unit V:
Case Studies: Digital camera, Bluetooth radio/modem, SDRAM and USB controllers.

Text Books:

1. ASIC Design in the Silicon Sandbox: A Complete Guide to Building Mixed-Signal Integrated Circuits by by Keith Barr.
2. Application-Specific Integrated Circuits by Michael John Sebastian Smith Addison-Wesley
3. Physical Design Essentials: An ASIC Design Implementation Perspective by Khosrow Golshan Springer,

Reference Books:

1. Regular Fabrics in Deep Sub-Micron Integrated-Circuit Design by Fan Mo, Robert K. Brayton Springer,
2. Bio-inspired Computing Machines By Daniel Mange, Marco Tomassini PPUR presses polytechnique

VLSL549 - FAULT TOLERANT DIGITAL SYSTEM DESIGN 4-0-0-4

Course Objectives:

1. To prepare the student to Understand concepts of fault-tolerant digital systems.

2. To give the student an understanding of the mathematical models for fault-tolerant digital systems.
3. To prepare the Students to Learn use of computer-aided evaluation tools for fault-tolerant digital systems.

Course Outcomes: At the end of the course, the students shall be able to

1. Students will Understand concepts of fault-tolerant digital systems.
2. Students will Learn design techniques for fault-tolerant digital systems.
3. Students will Introduce the mathematical models for fault-tolerant digital systems.
4. learn about Fault diagnosis, Fault tolerance measurement in digital system.
5. enhance capabilities about applications of fault tolerant designs in arithmetic units and systems.
6. use software reliability models and methods.

Course Contents:

Unit I:
Basic concepts of Reliability: Failures and faults, Reliability and failure rate, Relation between reliability & mean time between failure, Maintainability & Availability, reliability of series and parallel systems. Modeling of faults. Test generation for combinational logic circuits :conventional methods (path sesitisation,Boolean difference), Random testing, transition count testing and signature analysis.

Unit II:
Fault Tolerant Design-I: Basic concepts ,static,(NMR,use of error correcting codes), dynamic, hybrid and self purging redundancy, Sift-out Modular Redundancy (SMR), triple modular redundancy, SMR reconfiguration.

Unit III:
Fault Tolerant Design-II: Time redundancy, software redundancy, fail-soft operation, examples of practical fault tolerant systems, introduction to fault tolerant design of VLSI chips.

Unit IV:
Self checking circuits: Design of totally self checking checkers, checkers using m-out of a codes, Berger codes and low cost residue code, self-checking sequential machines, partially self-checking circuits. Fail safe Design: Strongly fault secure circuits, fail-safe design of sequential circuits using partition theory and Berger codes, totally self checking PLA design.

Unit V:
Design for testable combination logic circuits: Basic concepts of testability, controllability and observability. The Read-Muller expansion technique, level OR-AND-OR design, use of control and syndrome-testing design. Built-in-test, built-in-test of VLSI chips, design for autonomous self-test, design in testability into logic boards.

Text Books:

1. Parag K. Lala, Fault Tolerant & Fault Testable Hardware Design, (PHI) 1985
2. Parag K. Lala, Digital systems Design using PLD's, PHI 1990.

Reference Books:

1. N.N. Biswas, Logic Design Theory, PHI 1990.
2. Konad Chakraborthy & Pinaki Mazumdar, Fault tolerance and Reliability Techniques for high – density random – access memories Reason, 2002.

VLSL550 - CAD for IC Design 4-0-0-4

Course Objectives:

1. To provide adequate knowledge ofIC designing

2. To analyse the system ‘s steps and procedure of cad for ic design
3. Students will make extensive use of CAD tools for IC design, simulation, and layout verification.
4. .Specific techniques for designing high-speed, low-power, and easily-testable circuits will also be covered.

Course Contents:

Unit I: Matrices, Graphs, Algorithms data structures, efficient representation of graphs.

Unit II: Elementary graph algorithms involving bfs and dfs trees, such as finding connected and 2-connected components of a graph.

Unit III: the minimum spanning tree, shortest path between a pair of vertices in a graph.

Unit IV: Data structures such as stacks, linked lists and queues, binary trees and heaps.

Unit V: Time and space complexity of algorithms

Course Outcomes: At the end of the course, the students shall be able to

1. Students will Gain an in-depth understanding of theories related to digital IC design.
2. Students will Understand steps and procedure of circuit design.
3. Students will able to Implement IC for industrial and engineering applications related to IC development tools.
4. Ability to analyze high-frequency response of amplifiers
5. Ability to understand stability compensation for amplifiers
6. Ability to design and characterize amplifiers according to design specifications in Cadence CAD software

Text Books:

1. IC Design CAD HAN YAN ?HAN XIAO XIA ?DING KOU BAO
2. Digital VLSI Chip Design with Cadence and Synopsys CAD Tools Erik Brunvand
3. CMOS IC Layout: Concepts, Methodologies, and Tools Dan Clein

Reference Books:

1. Low-Power CMOS Circuits: Technology, Logic Design and CAD Tools, Christian Piguet
2. Architecture and CAD for Deep-Submicron FPGAsV. Betz, J. Rose, and A. Marquardt,

VLSL551 - Opto Electronics Devices and Systems 4-0-0-4

Course Objectives:

1. Understand the basic optoelectronics including electromagnetism, light propagation in waveguides, light amplification and detection, lasers, modulators, and detectors.
2. Be familiar with recent trends in optoelectronics.

Course Outcomes: At the end of the course, the students shall be able to

1. Analyze and Understand Terabit per second optical communication systems and associated technologies
2. Select, design and implement appropriate technologies for the implementation of optical fiber systems
3. An understanding of semiconductor material properties and semiconductor opto-electronic device physics
4. An overview of the current state and design of light emitting diodes and the related issues in the color vision of human being.
5. An in depth analysis of laser theory and rate equations in the design of lasers; and an overview of laser resonators and laser types.
6. An in depth analysis of optical fibers and the design of fiber optic systems for communications, including modulators, switches, and detectors.

Course Contents:

Unit I:
Elemental and Compound Semiconductors Electronic Properties of Semiconductors.

Unit II:
Optical Processes in Semiconductors Junction Theory Light Emitting Diodes Lasers: Operating Principles Lasers: Structures and Properties

Unit III:
Photodetectors Special Detection Schemes

Unit IV:
Solar Cells Optoelectronic Modulation and Switching Devices

Unit V:
Optoelectronic Integrated Circuits

Text Books:
1. Pallab Bhattacharya, "Semiconductor Optoelectronic Devices," 2nd edition, Prentice-Hall,1997 (ISBN: 0-13-495656-1).
2. S. O. Kasap, "Optoelectronics and Photonics: Principles and Practices," Prentice-Hall,2001
3. B. Streetman and S. Banerjee, "Solid State Electronic Devices," 6th edition, Pearson/Prentice Hall,2006

VLSL552 : VHDL AMS : 4-0-0-4

Course Objectives:
1. Learn how to create VHDL-AMS for analog, mixed-signal, and multi-disciplinary designs
2. Ability to simulate and synthesize techniques and processes.
3. Explaining high end utilities of modeling languages for analog, mixed-signal design.
4. Learn different hardware design based software.

Course Contents:

UNIT-I:
Fundamental Concepts , Scalar Data Types, Natures and Operations ,Sequential Statements , Composite Data Types and Operations.

UNIT-II:
Digital Modeling Constructs , Analog Modeling Constructs , Design Processing , Case Study 1: Mixed-Signal Focus , Subprograms , Packages and Use Clauses , Aliases , Generic Constants , Frequency and Transfer Function Modeling

UNIT-III:
Case Study 2: Mixed-Technology Focus , Resolved Signals ,Components and Configurations , Generate Statements , Case Study 3: DC-DC Power Converter , Guards and Blocks , Files and Input/Output , Attributes and Groups , Case Study 4: Communication System ,Miscellaneous Topics .

UNIT-IV:
Integrated System Modeling , Case Study 5: RC Airplane System A Using SPICE Models in VHDL-AMS B
UNIT V:The Predefined Package Standard C IEEE Standard Packages D Related Standards E VHDL-AMS

Course Outcomes: At the end of the course, the students shall be able to

1. Students will able to create VHDL-AMS for analog,
2. Students will able to create mixed-signal design and multi-disciplinary designs.
3. Students are able to test the functionality of Mixed signals
4. Students will able Verify the functionality and performance of the models created using the Virtuoso® AMS Designer simulator.
5. Exploit mixed-signal modeling techniques.
6. Produce quality and reusable VHDL-AMS models.

Text Books:

1. The System Designer's Guide to VHDL-AMS: Analog, Mixed-Signal, and Mixed-Technology ModelingPeter J. Ashenden (Author), Gregory D. Peterson (Author), Darrell A. Teegarden (Author), Peterson (Author)
2. An Extension to VHDL-AMS for AMS Systems with Partial Differential Equations Leran Wang, Chenxu Zhao, Tom J. Kazmierski
3. vhdl-ams in mems design flow Joachim Haase, Jens Bastian, Sven Reitz
4. **The VHDL Reference: A Practical Guide to Computer-Aided Integrated Circuit Design (Including VHDL-AMS) with Other**

VLSL553 - MATERIALS SYNTHESIS AND CHARACTERIZATION 4-0-0-4

Course Objectives

1. This course will cover key concepts in nanosynthesis and material characterization for graduate students and advanced undergraduates.
2. The goal of this class is to explore different strategies for synthesizing low-dimensional nanomaterials (e.g., nanocrystals, nanotubes, nanowires) and common techniques for nanoscale materials characterization.
3. The course will cover fundamental chemical principles of bonding, electronic structure, and atomic arrangements.

Course Outcomes: At the end of the course, the students shall be able to

1. Describe different materials classification and to explain the concept of structure/property relationship.
2. Understand the concept of molecular weight distribution in polymers, and explain how it is affected by the kinetics of polymerization reactions.
3. Identify examples of some important polymers, and explain how the molecular structure of these polymers affect their physical properties
4. Ability to make material balances on unit operations and processes
5. Ability to perform simultaneous material and energy balances
6. Understanding of the degrees of freedom analysis and its significance

Course Contents:

UNIT-I:
Thermal analysis; TGA; DTA; DSC; dilatometry; (Thermal expansion) Principles and applications.
UNIT-II:
Electron imaging techniques; SEM; TEM; FESEM; STM; AFM; SPM; HRTEM; HRSEM
UNIT-III:
Particle size measurement, surface area measurement, DC polarization, AC impedance measurements.

UNIT-IV:
Photoluminescence, Positron Annihilation Lifetime Spectroscopy, Non-linear electro-optical studies, mechanical properties, tensile strength, microhardness, conductivity measurements; particle size analysis; zeta potential.

Text Books:

1. Sam Zhang, Lin Li and Ashok Kumar, Materials Characterization Techniques, CRC Press, (2008)
2. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Wiley & Sons (2008)
3. Elton N. Kaufmann, Characterization of Materials, Vol.1, Wiley & Sons (2003)

Reference Books:

1. R.A. Laudise, Growth of Single Crystals, Prentice Hall, (1973)
2. G. Dhanaraj, K. Byrappa, V. Prasad and M. Dudley (Eds.), Springer Handbook of Crystal Growth, Springer-Verlag (2010)
3. Peter E.J. Flewitt and R.K. Wild, Physical Methods of Materials Characterization, 2nd Edition, Taylor & Francis (2003)