CURRICULUM & SYLLABUS

MASTER OF TECHNOLOGY
in
VLSI Design

(For students admitted in 2008-09 and afterwards)

DEPARTMENT OF ECE
Faculty of Engineering and Technology, SRM University
SRM Nagar, Kattankulathur – 603203, Kancheepuram District, Tamilnadu
GUIDELINES FOR SELECTING COURSES

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Category</th>
<th>I Semester</th>
<th>II Semester</th>
<th>III Semester</th>
<th>IV Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Core Courses</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Elective Courses</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Supportive Courses</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Seminar</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Project Work*</td>
<td>-</td>
<td>-</td>
<td>1*</td>
<td>1**</td>
</tr>
</tbody>
</table>

* Main Project - Phase I
** Main Project - Phase II

CORE COURSES

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL0501</td>
<td>Programming in HDL</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>VL0502</td>
<td>Digital Signal Processing structures for VLSI</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>VL0503</td>
<td>DSP Architectures and Applications</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>VL0504</td>
<td>CMOS Analog circuit design</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>VL0505 or</td>
<td>Testing of VLSI Circuits or VLSI Technology</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>VL0506</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VL0507 or</td>
<td>Digital VLSI Design or Solid State Device Modeling and Simulation</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>VL0508</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OPTIONAL / ELECTIVE COURSES

Program Electives

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Course Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL0551</td>
<td>Low Power VLSI Design</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0552</td>
<td>CMOS Mixed signal Circuit Design</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0553</td>
<td>Neural Networks and Applications</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0554</td>
<td>VLSI Design Automation</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0555</td>
<td>Design of Semiconductor Memories</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0556</td>
<td>VLSI Digital Signal Processing systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0557</td>
<td>Computer Architecture and parallel Processing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0558</td>
<td>System-on-Chip design</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0559</td>
<td>Genetic Algorithms and their Applications</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0560</td>
<td>Reliability Engineering</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0561</td>
<td>Fundamentals and applications of MEMS</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0562</td>
<td>Nano Electronics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Course code</td>
<td>Course Title</td>
<td>L</td>
<td>T</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>VL0563</td>
<td>Speech and Audio Signal Processing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>EM0559</td>
<td>Embedded wireless Sensor Networks</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CO0554</td>
<td>Electromagnetic Interference and Compatibility in System Design</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**Supportive Courses**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA0515</td>
<td>Graph Theory and Optimization Techniques</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0509</td>
<td>ASIC Design</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0510</td>
<td>Magnetoelectronics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VL0516</td>
<td>Reconfigurable Computing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**Other courses**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Title</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL0601</td>
<td>Project Work – Phase - I</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>VL0602</td>
<td>Project Work – phase - II</td>
<td>0</td>
<td>0</td>
<td>36</td>
<td>18</td>
</tr>
</tbody>
</table>
VL0501 PROGRAMMING IN HDL

Pre-requisite: Nil

L  T  P  C
3  0  3  4

PURPOSE
HDL programming is fundamental for VLSI design and hence this course is given.

INSTRUCTIONAL OBJECTIVES
The student will be able to write programs in VHDL and Verilog HDL for modeling digital electronic circuits.

SYLLABUS CONTENTS

**Basic concepts:** Operators, Data types, Number specification, System tasks and compiler directives, Modules and ports, Gate-level Modeling, Dataflow Modeling, Behavioral Modeling-example for each modeling - test bench-lab exercise.

Tasks and Functions-example-useful modeling techniques-Timing and delays-Switch level modeling-user defined primitives- lab exercise.

Basic Concepts: Data Objects, Data Types, Operators, Concurrent and Sequential Assignment Statements, Different Styles of Modeling, Simple Examples-test bench- lab exercise.

Procedure and functions - examples-packages - Generic constants and statements - examples. Component and configuration-lab exercise.

Introduction to synthesis - Verilog synthesis-modeling tips for Verilog logic synthesis-combinational and sequential logic synthesis using VHDL-VHDL modeling restrictions- lab exercise.

REFERENCE BOOKS
2. Peter J.Ashenden, ”The designer guide to VHDL”, 2001
PURPOSE
DSPs are used in many application areas and hence have become an essential part of VLSI. This course is intended to introduce the students about DSP structures, this subject is included.

INSTRUCTIONAL OBJECTIVES
After this course the student will know fundamentals of DSP and various structures useful in DSP implementation.

SYLLABUS CONTENTS

Introduction to Digital Signal Processing
Linear System Theory- Convolution- Correlation - DFT- FFT- Basic concepts in FIR Filters and IIR Filters - Filter Realizations. Representation of DSP Algorithms - Block diagram-SFG-DFG.

Iteration Bound, Pipelining and Parallel Processing of FIR Filter

Fast Convolution and Arithmetic Strength Reduction in Filters

Pipelined and Parallel Recursive Filters
Pipelined and Parallel Recursive Filters : Pipeline Interleaving in Digital Filters- Pipelining in 1st Order IIR Digital Filters- Pipelining in Higher- Order IIR Filters-Clustered Look ahead and Stable Clustered Look ahead- Parallel Processing for IIR Filters and Problems.

Scaling and Roundoff Noise

REFERENCE BOOKS
**PURPOSE**
This course introduces Digital Signal processors.

**INSTRUCTIONAL OBJECTIVES**
At the end of this course the student will know various DSPs and their architectures and uses.

**SYLLABUS CONTENTS**

**Overview of Digital Signal Processing**
Advantages of DSP over analog systems, salient features and characteristics of DSP systems, applications of DSP systems.

Introduction to DSP Processors: Common features of DSP processors, numeric representations in DSP processor, data path of a DSP processor, memory structures in DSP processors, VLIW architecture, special addressing modes in DSP processors, pipelining concepts, on-chip peripherals found in DSP processors.

**TMS320C5X Processors**
Architecture of TMS320C5X Processors- Assembly Instructions- Addressing Modes- Pipelining and Peripherals-Lab exercises

**TMS320C3X Processors**
Architecture of TMS320C3X- Instruction Set- Addressing Modes- Data Formats- Floating Point Operation- Pipelining and Peripherals- Lab exercises

**Black fin Processor**
Introduction to Black fin processor- Architecture overview-processor core-addressing modes-instruction sets- Targeted applications - Lab exercises.

**SHARC Processor**

**REFERENCE BOOKS**
PURPOSE
Analog circuits are essential in interfacing and in building amplifiers and low pass filters. This course introduces design methods for CMOS analog circuit design.

INSTRUCTIONAL OBJECTIVES
At the end of this course the student will be learning, CMOS analog circuits design and simulation using SPICE.

SYLLBUS CONTENT

CMOS Technology & Device Modeling

Introduction: Terminologies – analog and digital signals, analog sampled-data or discrete time signal, circuit design, analysis of a circuit, synthesis of a circuit, differences between integrated and discrete analog circuit design, design process of an analog integrated circuit.

CMOS Technology: Basic MOS fabrication processes, PN junction, MOS transistor, passive components, lateral and substrate BJT and latchup.

CMOS Device Modeling: Large-signal and small-signal model for the MOS transistor, computer simulation models, simulation of MOS circuits using SPICE.

CMOS subcircuits
MOS switch, MOS diode/ active resistor, current sinks and sources, current mirrors, current and voltage references, bandgap reference, simulation of CMOS sub circuits using SPICE.

CMOS amplifiers

CMOS amplifiers: Common-Source stage (with resistive load, diode connected load, current-source load, triode load, source degeneration), source follower, common-gate stage, cascode stage, folded cascode stage, simulation of CMOS amplifiers using SPICE.

Differential amplifier: Single-ended operation, differential operation, basic differential pair, large-signal and small-signal behaviour, common-mode response, differential pair with MOS loads, simulation of differential amplifiers using SPICE.

Operational Amplifiers & Frequency Response

Noise Characteristics
Noise characteristics in the frequency and time domains, thermal noise, shot noise, flicker noise, popcorn noise, noise models of IC components, representation of noise in circuits, noise in single-stage amplifiers (CS, CD and CG stages), noise in differential pairs, noise bandwidth, noise figure, noise temperature.

REFERENCE BOOKS
PURPOSE
Testing VLSI is essential as these circuits are complex. Hence this paper deals with fundamental techniques used for logic testing.

INSTRUCTIONAL OBJECTIVES
At the end of the course the student will be having knowledge on digital testing as applied to VLSI design.

SYLLABUS OUTLINE

Basics of Testing and Fault modeling

Test generation for combinational circuits

Test generation and Testability of sequential circuits

Memory, Delay fault and IDDQ Testing
Delay test - Path delay test and fault models - Transition faults - delay test methodologies - practical consideration - IDDQ testing - Testing methods - Limitations of IDDQ testing - DFT IDQ.

Built-in Self-Test
DFT - Scan Design - Partial scan design - BIST- TPG for BIST - output response analysis, BIST Architectures- Random Logic BIST - Memory and delay fault BIST - JTAG - System test and core based design.

REFERENCE BOOKS
PURPOSE
This paper deals with manufacturing of VLSI devices.

INSTRUCTIONAL OBJECTIVES
After completing this course, the students will be knowing about various technologies used for fabricating VLSI devices.

SYLLABUS CONTENTS

Crystal growth, wafer preparation, epitaxy and oxidation
Electronic Grade Silicon, Czochralski crystal growing, Silicon Shaping, processing considerations, Vapor phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation, Growth Mechanism and kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxide properties, Redistribution of Dopants at interface, Oxidation of Poly Silicon, Oxidation inducted Defects.

Lithography and relative plasma etching
Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography, Plasma properties, Feature Size control and Anisotropic Etch mechanism, reactive Plasma Etching techniques and Equipment.

Deposition, Diffusion, Ion implementation and Metallization

Process simulation and VLSI process integration

Analytical, Assembly Techniques and Packaging of VLSI Devices

REFERENCE BOOKS
PURPOSE
This course deals with fundamentals of electronics involved in the design of VLSI circuits.

INSTRUCTIONAL OBJECTIVES
At the end of the course, students should be able to understand
- CMOS processing technology and Basic CMOS circuits, characteristics and performance
- Designing of combinational and sequential circuits in CMOS

SYLLBUS CONTENTS

Introduction to MOS Device
MOS Transistor-First Glance at the MOS device MOS Transistor under static conditions-threshold voltage- Resistive operation-saturation region -channel length modulation-velocity saturation-Hot carrier effect-drain current Vs voltage charts - sub threshold conduction - equivalent resistance-MOS structure capacitance-Design logic gates using NMOS and PMOS and CMOS devices-Stick Diagram.

MOS Transistor Device Modeling

CMOS combinational logic design
Static CMOS design-complementary CMOS - static properties- complementary CMOS design-Power consumption in CMOS logic gates-dynamic or glitching transitions - Design techniques to reduce switching activity - Radioed logic-DC VSL - pass transistor logic - Differential pass transistor logic - Sizing of level restorer-Sizing in pass transistor-Dynamic CMOS design-Basic principles - Domino logic-optimization of Domino logic-NPCMOS-logic style selection -Designing logic for reduced supply voltages

CMOS sequential logic design

CMOS subsystem design

REFERENCE BOOKS
PURPOSE
This course deals with modeling devices and their fundamental working concepts.

INSTRUCTIONAL OBJECTIVES
By studying this subject the student will be able to make models of transistor circuits and simulate them for various operational requirements.

SYLLABUS CONTENTS
Quantum Mechanical Concepts, Carrier Concentration, Transport Equation, Band gap, Mobility and Resistivity, Carrier Generation and Recombination, Avalanche Process, Noise Sources.

Injection and Transport Model, Continuity Equation, Diode Small Signal and Large Signal (Change Control Model), Transistor Models: Ebber - Mollis and Gummel Port Model, Mextram model, SPICE modeling temperature and area effects.

Introduction Interior Layer, MOS Transistor Current, Threshold Voltage, Temperature Short Channel and Narrow Width Effect, Models for Enhancement, Depletion Type MOSFET, CMOS Models in SPICE.

General Methods, Specific Bipolar Measurement, Depletion Capacitance, Series Resistances, Early Effect, Gummel Plots, MOSFET: Long and Short Channel Parameters, Statistical Modeling of Biopolar and MOS Transistors.

Static and Dynamic Models, Rate Equations, Numerical Technique, Equivalent Circuits, Modeling of LEDs, Laser Diode and Photo-detectors.

REFERENCE BOOKS
PURPOSE
As there is always a need for power efficient circuits and devices, this course explain the methods for low power VLSI design.

INSTRUCTIONAL OBJECTIVES
At the end of this course the student will be able to design Low power CMOS designs, for digital circuits.

SYLLABUS CONTENT

Introduction to low power VLSI design and analysis
Introduction to low power VLSI design-Need for low power-CMOS leakage current-static current-Basic principles of low power design-probabilistic power analysis-random logic signal-probability and frequency- power analysis techniques-signal entropy.

Circuit level and logic level design techniques
Circuit - transistor and gate sizing - pin ordering - network restructuring and reorganization - adjustable threshold voltages - logic-signal gating - logic encoding. Pre-computation logic.

Special low power VLSI design techniques - I
Power reduction in clock networks - CMOS floating node - low power bus - delay balancing - SRAM.

Special low power VLSI design techniques - II
Switching activity reduction - parallel voltage reduction - operator reduction -Adiabatic computation - pass transistor logic

Software design and power estimation
Low power circuit design style - Software power estimation – co-design.

REFERENCE BOOKS
PURPOSE
As many real life applications involve both analog and digital circuits, this course aims to introduce the problems in implementing both in a single silicon wafer.

INSTRUCTIONAL OBJECTIVE: At the end of the course the student will be knowing mixed signal designs like DAC, ADC, PLL etc.

SYLLABUS CONTENT

NON-LINEAR ANALOG CIRCUITS
Characterization of a comparator, basic CMOS comparator design, analog multiplier design, PLL – simple PLL, charge-pump PLL, applications of PLL.
Switched Capacitor circuits – basic principles, some practical circuits such as switched capacitor integrator, biquad circuit, switched capacitor filter, switched capacitor amplifier, non-filtering applications of switched capacitor circuit such as programmable gate arrays, DAC and ADC, MOS comparators, modulators, rectifiers, detectors, oscillators.

SAMPLING CIRCUITS
Basic sampling circuits for analog signal sampling, performance metrics of sampling circuits, different types of sampling switches.
Sample-and-Hold Architectures: Open-loop & closed-loop architectures, open-loop architecture with miller capacitance, multiplexed-input architectures, recycling architecture, switched capacitor architecture, current- mode architecture.

DIGITAL-TO ANALOG CONVERSION
Input/output characteristics of an ideal D/A converter, performance metrics of D/A converter, D/A converter in terms of voltage, current, and charge division or multiplication, switching functions to generate an analog output corresponding to a digital input.

D/A converter architectures: Resistor-Ladder architectures, current-steering architectures.

ANALOG-TO-DIGITAL CONVERSION
Input/output characteristics and quantization error of an A/D converter, performance metrics of A/D converter.

A/D converter architectures: Flash architectures, two-step architectures, interpolate and folding architectures, pipelined architectures, Successive approximation architectures, interleaved architectures.

ANALOG CMOS FILTERS
Low Pass filters, active RC integrators, MOSFET-C integrators, transconductance-c integrator, discrete time integrators. Filtering topologies – bilinear transfer function and biquadratic transfer function.

REFERENCE BOOKS
PURPOSE
The purpose of this course is to introduce neural network concepts to the student, as it is an emerging application area for VLSI.

INSTRUCTIONAL OBJECTIVES
At the end of the course, the student will acquire knowledge on neural networks, its theory and various types.

SYLLABUS CONTENTS

Artificial Neural Network Learning Algorithms

Pattern Recognition
Cover's Theorem on the Separability of Patterns - Exact Interpolator - Regularization Theory - Generalized Radial Basis Function Networks - Learning in Radial Basis Function Networks - Applications: XOR Problem - Image Classification.


Hierarchical Mixture of Experts Model

Neurodynamic Systems

Adaptive Resonance Theory and Self Organizing Map


REFERENCE BOOKS
PURPOSE
There is a great need for methods to automate VLSI design methods. This course introduces the automation techniques.

INSTRUCTIONAL OBJECTIVES
After going through this course student will be having knowledge on automation methods for VLSI design.

SYLLABUS CONTENTS

Introduction to VLSI Design methodologies

Layout Compaction, Placement & Partitioning
Layout Compaction: Design rules - problem formulation - algorithms for constraint graph compaction –
Placement & Partitioning: Circuit representation - Placement algorithms - partitioning

Floorplanning & Routing
Floor planning concepts: Terminologies, floorplan representation, shape functions and floorplan sizing
Routing: Types of local routing problems - Area routing - channel routing - global routing - algorithms for global routing.

VLSI Simulation
Gate-level modeling and simulation - Switch-level modeling and simulation - Combinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis- High level Synthesis.

High Level Synthesis
Hardware models - Internal representation - Allocation assignment and scheduling - Simple scheduling algorithm - Assignment problem – High level transformations.

REFERENCE BOOKS
PURPOSE
Memory is an important part in many digital circuits and microcontrollers. This course discusses implementation methods and problems in designing and making semiconductor memories.

INSTRUCTIONAL OBJECTIVES
At the end of this course, the student will be able to know the design of MOS memories and the various precautionary methods to be used in the design and fabrication of them.

SYLLABUS CONTENTS

SRAM
SRAM Cell Structures-MOS SRAM Architecture-MOS SRAM Cell and Peripheral Circuit Operation-Bipolar SRAM Technologies- SOI Technology-Advanced SRAM Architectures & Technologies-Application Specific SRAMs.

DRAM

ROM
Masked Read-Only Memories (ROMs)-High Density ROMs-Programmable Read-Only Memories (PROMs)-Bipolar PROMs-CMOS PROMs-Erasable (UV) - Programmable Road-Only Memories (EPROMs)-Floating-Gate EPROM Cell-One-Time Programmable (OTP) EPROMs-Electrically Erasable PROMs (EEPROMs) - EEPROM Technology And Architecture-Nonvolatile SRAM-Flash Memories (EPROMs or EEPROM)-Advanced Flash Memory Architecture.

Testing & Reliability Issues

Emerging memory architectures

REFERENCE BOOKS
PURPOSE
As DSP has become an essential component of VLSI applications, this circuit is introduced.

INSTRUCTIONAL OBJECTIVES
At the end of this course the student will be able knowing methods and techniques for implementation of DSP systems.

SYLLBUS CONTENTS

Unfolding & Folding

Bit-Level Arithmetic Architectures
- Parallel Multipliers- Interleaved Floor-plan and Bit-Plane-Based Digital Filters- Bit-Serial Multipliers- Bit-serial Filter Design and Implementation- Canonic Signed Digit Arithmetic- Distributed Arithmetic.

Redundant Arithmetic

Synchronous, Wave & Asynchronous Pipelines
- Synchronous Pipelining and Clocking Styles- Clock Skew and Clock Distribution in Bit-Level Pipelined VLSI Designs- Wave Pipelining- Constraint Space Diagram and Degree of Wave Pipelining- Implementation of Wave-Pipelined Systems- Asynchronous Pipelining- Signal Transition Graphs- Use of STG to Design Interconnection Circuits- - Implementation of Computational Units.

Low-Power design

REFERENCE BOOKS
**PURPOSE**
Any VLSI design mostly involves processor systems, this course describes computer architectures.

**INSTRUCTIONAL OBJECTIVES**
At the end of this course the student will be knowing various processor implementation architectures.

**SYLLABUS CONTENTS**

*Parallel Computer Models*
Multiprocessors and Multicomputers – Multivector and SIMD Computers- PRAM and VLSI Models-Conditions of Parallelism- Program Partitioning and scheduling-program flow mechanisms- parallel processing applications- speed up performance law.

*Hardware Technologies*
Advanced processor technology – Superscalar and vector processors- Memory hierarchy technology- Virtual memory technology- Cache memory organization- Shared memory organization.

*Pipelining and Superscalar Techniques*
Linear pipeline processors- Non linear pipeline processors- Instruction pipeline design- Arithmetic design- Superscalar and super pipeline design- Multiprocessor system interconnects- Message passing mechanisms.

*Multivector and SIMD Computers*
Vector Processing principle- Multivector Multiprocessors- Compound Vector processing- Principles of multithreading-fine grain multicomputers- scalable and multithread architectures – Dataflow and hybrid architectures.

*Parallel Programming*
Parallel programming models- parallel languages and compilers- parallel programming environments-synchronization and multiprocessing modes- message passing program development- mapping programs onto multicomputers- multiprocessor UNIX design goals- MACH/OS kernel architecture- OSF/1 architecture and applications.

**REFERENCE BOOKS**
**PURPOSE**
IP cores and application specific design is becoming the order of the day. Because of usefulness of this for both VLSI and embedded students this subject is provided.

**INSTRUCTIONAL OBJECTIVES**
To make the student learn System-on-chip fundamentals, their applications and On-chip networking methods.

**SYLLABUS CONTENT**

**Part-A: SOC**

**SOC fundamentals**

**Unit-II: SOC software and energy management**
SoC embedded software – energy management techniques for SoC design.

**Part- B: On-chip networking**

**System design and methodology**
Design methodology for NOC based systems – Mapping concurrent application onto architectural platforms.

**Hardware and basic infrastructure**
Packet switched network for on-chip communication – energy reliability tradeoff for NoC’s – clocking strategies – parallel computer as a NoC’s region.

**Software and application interfaces**
MP-SoC from software to hardware – NoC APIs – multilevel software validation for NoC – Software for network on chip

**REFERENCE BOOKS**
PURPOSE
Optimization methods are necessary for making circuits and making device layouts. This course deals with GA as an optimization application for VLSI design.

INSTRUCTIONAL OBJECTIVES
At the end of the course student will be able to know the GA and its application methods.

SYLLABUS CONTENTS

An Overview of Genetic Algorithms

Genetic algorithm in problem solving

Genetic Algorithms in Scientific Models
Natural evolution – Simulated annealing and Tabu search .Genetic Algorithm in scientific models and theoretical foundations.

Implementing a Genetic Algorithm
Computer implementation - low level operator and knowledge based techniques in Genetic Algorithm.

Applications of Genetic based machine learning
Applications of Genetic based machine learning-Genetic Algorithm and parallel processors, composite laminates, constraint optimization, multilevel optimization, real life problem.

REFERENCE BOOKS
POUROSE
For any system reliability is an essential parameter. For evaluating reliability of designs it is necessary to know reliability analysis methods. Hence this course is offered.

INSTRUCTIONAL OBJECTIVES
At the end of this course, the student would have learnt basics of reliability evaluation methods and its application to electronic circuits and failure modes of many electronic components.

SYLLABUS CONTENTS
Statistical distribution, statistical confidence and hypothesis testing, probability plotting techniques – Weibull, extreme value, hazard, binomial data; Analysis of load – strength interference, Safety margin and loading roughness on reliability.

Statistical design of experiments and analysis of variance Taguchi method, Reliability prediction, Reliability modeling, Block diagram and Fault tree Analysis, petric Nets, State space Analysis, Monte carlo simulation, Design analysis methods – quality function deployment, load strength analysis, failure modes, effects and criticality analysis.

Reliability of electronic components, component types and failure mechanisms, Electronic system reliability prediction, Reliability in electronic system design; software errors, software structure and modularity, fault tolerance, software reliability, prediction and measurement, hardware/software interfaces.

Test environments, testing for reliability and durability, failure reporting, Pareto analysis, Accelerated test data analysis, CUSUM charts, Exploratory data analysis and proportional hazards modeling, reliability demonstration, reliability growth monitoring.

Control of production variability, Acceptance sampling, Quality control and stress screening, Production failure reporting; preventive maintenance strategy, Maintenance schedules, Design for maintainability, Integrated reliability programmes, reliability and costs, standard for reliability, quality and safety, specifying reliability, organization for reliability.

REFERENCE BOOKS
PURPOSE
This course is an introduction to MEMS, which also uses micro electronics. This course fulfills the need of electronic engineer who want to create MEMS devices.

INSTRUCTIONAL OBJECTIVES
At the end of this course, the student will have knowledge on MEMS materials, fabrication and micro sensor design.

SYLLABUS CONTENTS

Overview of MEMS and Microsystems
MEMS and Microsystems, Microsystems and microelectronics, Microsystems and miniaturization, Working principle of micro system – Micro sensors, Micro actuators, MEMS with Micro actuators.

Materials For MEMS
Substrate and wafer, silicon as a substrate material, silicon compound, silicon Piezoresistors, Gallium Arsenide, quartz, Piezoelectric crystals, polymers and packaging Materials.

Microsystems Fabrication Process

Microsystems Design, Assembly and Packaging
Micro system Design – Design consideration, process design, Mechanical design, Mechanical design using MEMS. Mechanical packaging of Microsystems, Microsystems packaging, interfacing in Microsystems packaging, packaging technology, selection of packaging materials, signal mapping and transduction.

Case Study of MEMS Devices
Case study on strain sensors, Temperature sensors, Pressure sensors, Humidity sensors, Accelerometers, Gyroscopes, RF MEMS Switch, phase shifter, and smart sensors. Case study of MEMS pressure sensor Packaging.

REFERENCE BOOKS
PURPOSE
As a new and expanding field, with many implications, nanotechnology and nanoelectronics is going to pave way for new technologies. Hence this course introduced.

INSTRUCTIONAL OBJECTIVES
At the end of this course, the student will have knowledge on MEMS materials, fabrication and micro sensor design.

SYLLABUS CONTENT


Technology: Film deposition methods – Lithography.


Spintronics: Principle – Applications, Quantum computing, nano sensors.

REFERENCE BOOKS
PURPOSE
Speech processing is an essential area in which many applications can be developed. This course gives fundamental knowledge in this area.

INSTRUCTIONAL OBJECTIVES
At the end of this course, the student will know speech fundamentals, its signal analysis and artificial reproduction theory, and some knowledge on recognition.

SYLLABUS CONTENTS

Fundamentals of Human speech Production

Time-Domain Methods for Speech Processing

Frequency-Domain Representations

Formulation of Linear Prediction problem in Time Domain

Algorithms

REFERENCE BOOKS
PURPOSE
To make the student understand and apply the theory behind wireless sensor networks.

INSTRUCTIONAL OBJECTIVES
To impart students with wireless sensor network fundamentals.

SYLLABUS CONTENT

Introduction

Communication
Source detection and identification – digital communications – multiple source estimation and multiple access communications.

Networking
Networking – network position and synchronization services.

Network management
Energy management – data management – articulation mobility and infrastructure.

Nodes, data and application
Node architecture – network data integrity – experimental system design.

REFERENCE BOOKS
### Purpose
The purpose of this course is to expose the students to the basics and fundamentals of Electromagnetic Interference and Compatibility in System Design.

### Instructional Objectives
At the end of the course, students should be able to know:
- EMI Environment.
- EMI Coupling Principles.
- EMI Specification, Standards and Limits.
- EMI Measurements and Control Techniques.
- EMC Design of PCBs.

### Syllabus Contents
EMI/EMC concepts and definitions, Sources of EMI, conducted and radiated EMI, Transient EMI, Time domain Vs Frequency domain EMI, Units of measurement parameters, Emission and immunity concepts, ESD.

Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, Near Field Cable to Cable Coupling, Power Mains and Power Supply coupling.

Civilian standards - FCC, CISPR, IEC, EN, Military standards - MIL STD 461D/462, EMI Test Instrument /Systems, EMI Shielded Chamber, Open Area Test Site, TEM Cell, Sensors/Injectors/Couplers, Test beds for ESD and EFT.

Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting.


### Reference Books
### PURPOSE
This Course is aimed at providing graph theory and optimization techniques for use in VLSI design.

### INSTRUCTIONAL OBJECTIVES
At the end of this course the student will be able to know, graph theory basics, application of it in optimization techniques.

### SYLLABUS CONTENTS

#### Paths and Circuits

#### Graphs & Graph Colorings
Eulerian graphs and Hamiltonian graphs – Standard theorems – Planar graphs – Euler’s formula – Five colour theorem – Coloring of graphs – Chromatic number (vertex and edge) properties and examples – Directed graphs.

#### Applications

#### Optimization Techniques

#### Unconstrained Minimization Methods

### REFERENCE BOOKS
1. Narsingh Deo, “Graph Theory with Applications to Engineering and Computer Science,” PHI.
PURPOSE
As VLSI implementation is largely in ASIC, this subject is introduced here.

INSTRUCTIONAL OBJECTIVES
To make the student learn the fundamentals of ASIC and its design methods.

SYLLABUS CONTENT

Anti fuse – static RAM – EPROM and EEPROM technology – PREP benchmarks – Actel ACT – Xilinx LCA – Altera FLEX – Altera Max DC & AC inputs and outputs – Clock & Power inputs – Xilinx I/O blocks.


Planar subset problem(PSP) – single layer global routing single layer detailed routing wire length and bend minimization technique-over the cell(OTC) Routing-multichip modules(MCM)-Programmable logic arrays- Transistor chaining-Weinberger Arrays-Gate Matrix Layout-ID Compaction-2D compaction

REFERENCE BOOKS
PURPOSE
The scaling of CMOS is believed to reach the limit and hence, scope for other devices is currently under extensive research. The other freedom of electron other than tit charge and mass, the spin, is the basis of magnetoelectronics.. This course aims to introduce the new area of nanoelectronics namely, magnetoelectronics, various devices, applications and few simulation softwares..

INSTRUCTIONAL OBJECTIVES
At the end of the course, the student will gain knowledge about upcoming magnetoelectronic devices and the simulation of these devices.

SYLLABUS CONTENT

INTRODUCTION TO MAGNETOELECTRONICS
Introduction – What is magnetoelectronics – Key Engineering Issues Magnetoelectronics must solve – Spin vs Charge – Transport in Semiconductors, Metals- Spin-Polarized Current – Spin-Dependent Tunneling in Magnetic Tunnel Junction

SPIN VALVES

MAGNETIC TUNNEL JUNCTION

MAGNETORESISTIVE RANDOM ACCESS MEMORY

MICROMAGNETIC SIMULATION

REFERENCE BOOKS
PURPOSE
Scientific community has started exploring reconfigurable computing as a new and innovative technology for accelerating parallel computing. Reconfigurable devices are outpacing the microprocessor industry. The flexibility raises the possibility of meta-architecture; "morphing" hardware configurations with software as needed to improve efficiency, robustness, security and capability on-the-fly. This course aims to investigate the state-of-the-art in reconfigurable computing both from a hardware and software perspective; understand both how to architect reconfigurable systems and how to apply them to solving challenging computational problems.

INSTRUCTIONAL OBJECTIVES
At the end of the course, the students will gain knowledge in reconfigurable computing and its application area.

SYLLABUS CONTENT

INTRODUCTION
Goals and motivations - History, state of the art, future trends-Basic concepts and related fields of study-Performance, Power, and other metrics -Algorithm analysis and speed up projections- RC Architectures-Device characteristics-Fine-grained architectures- Coarse grained architectures.

FPGA DESIGN

PARALLEL PROCESSING

ARCHITECTURES
Hybrid architectures-communications-HW/SW partitioning-Soft-core microprocessors-System architectures-system design strategies-System services-Small-scale architectures-HPC-architectures-HPEC architectures-System synthesis-Architectural design space explorations.

CASE STUDY
Case Studies-Signal and image processing-Security-Special Topics-Partial Reconfiguration-Numerical Analysis-Performance Analysis/Prediction-Fault Tolerance.

TEXT BOOKS