M Tech. (VLSI and Embedded Systems)

Syllabus
### First Semester

<table>
<thead>
<tr>
<th>Course code</th>
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<th>Internal marks</th>
<th>External marks</th>
<th>Total Marks</th>
<th>C/E</th>
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**Total credits to be acquired:** 17

### Second Semester

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**Total credits to be acquired:** 19

### Third Semester

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### Fourth Semester

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**Total credits to be acquired for all semesters:** 72
ELV3101  ADVANCED DIGITAL SYSTEM DESIGN

Unit 1
**MSI and LSI circuits and their applications**: Arithmetic circuits, comparators, Multiplexers, Code Converters, XOR & AOI Gates, Wired Logic, Bus oriented structures, Tri-state bus systems, Propagation Delay

Unit 2
**Sequential Circuit Design**: Clocked Synchronous State Machine Analysis, Mealy and Moore machines, Finite State Machine design procedure – derive state diagrams, obtain state tables, state reduction methods, state assignments. Incompletely specified state machines. Implementing the states of FSM

Unit 3
**Designing with Programmable Logic Devices**: Read – Only Memories, Programmable Array Logic PALs, Programmable Logic Arrays PLAs – PLA minimization and PLA folding, Other Sequential PLDs, Design of combinational and sequential circuits using PLD’s. XILINX FPGAs – Configurable Logic Block (CLB), Input/ Output Block(IOB), Programmable Interconnection Points(PIP), XILINX CPLDs

Unit 4
**Asynchronous sequential circuits**: Derivation of excitation table, Race conditions and cycles, Static and dynamic hazards, Methods for avoiding races and hazards, essential hazards, Designing with SM charts – State machine charts, Derivation of SM charts, and Realization of SM charts.

Unit 5
**Advanced Topics in Boolean algebra**: Shannon’s Expansion Theorem, Consensus Theorem, Reed Muller Expansion, Design of Static Hazard free and dynamic hazard free logic circuits, Threshold logic, Symmetric functions.

TEXT BOOKS

REFERENCES

ELV3102  ADVANCED DSP

Unit 1
**Overview of one-dimensional DSP**: Sampling of Continuous and Discrete signals, Z-Transform, DFT, FFT, Discrete Hilbert Transform, DWT. Design of FIR and IIR filters. Finite word length effects in signal processing.

Unit 2
**Multirate system fundamentals**: Basic Multirate operation – upsampling and down sampling, Time domain and frequency domain analysis, identities for multirate operations, Interpolator and decimator design, Rate conversion, Polyphase representation.

Unit 3

Unit 4

Unit 5
**Signal Processing Hardware**: General purpose Digital Signal Processors- Texas Instruments TMS320 family, Motorala DSP 56333 family, Analog devices ADSP 2100 family. Instruction set of TMS320C50- simple programs. Real – time implementation considerations
TEXT BOOKS

REFERENCES
2. “Multirate Systems and filterbanks”, P P Vaidyanathan, Prentice Hall, PTR.

ELV3103 ANALOG VLSI

Unit 1
Analog MOS transistor models - Temperature effects and Noise in MOS transistor- MOS resistors, characterization of resistive, capacitive elements and MOS devices. Passive and active CMOS current sink/sources – basics of single stage CMOS amplifiers - common Source, common gate and source follower stages - frequency response

Unit 2
CMOS Differential Amplifiers: CMOS Operational Amplifiers- one stage and two stage- gain boosting- Common mode feedback (CMFB) - Cascode and Folded cascade structures

Unit 3
High Performance Opamps – High speed/ high frequency op-amps, micro power opamps, low noise opamps and low voltage opamps. Current mirrors, filter implementations.

Unit 4
Supply independent and temperature independent references-Band gap references- PTAT current generation and constant Gm biasing – CMOS comparators – Multipliers and wave shaping circuits – effects due to non-linearity and mismatch in MOS circuits – Layout and packaging consideration for analog circuits – design rules – multi finger transistors – substrate coupling etc.

Unit 5
Switched Capacitor Circuits: First and Second Order Switched Capacitor Circuits, Switched Capacitor filters, CMOS oscillators, simple and charge pump CMOS PLLs- non ideal effects in PLLs, Delay locked loops and applications, basics of CMOS data converters – Medium and high speed CMOS data converters, Over sampling converters.

TEXT BOOKS

REFERENCES

ELV3104 ELECTRONIC DESIGN AUTOMATION TOOLS

Unit 1

Unit 2
Unit 3  
**Tools for Circuit Design and Simulation using PSPICE:** PSPICE models for transistors, A/D &D/A, Sample and Hold circuits etc. Digital System building blocks, Design and analysis of analog and digital circuits using PSPICE.

Unit 4  
**An overview of Mixed Signal VLSI Design:** Fundamentals of analog and digital Simulation, Mixed Signal Simulator configurations, Understanding modeling, Integration to CAE environments, Analysis of analog circuits, eg. A/D &D/A converters, up and down converters, Componders etc.

Unit 5  
**Tools for PCB Design and Layout:** An overview of high speed PCB Design, design entry, Simulation and layout tools for PCB, Introduction to OrCAD PCB design tools

**TEXT BOOKS**


**REFERENCES**

1. ORCAD: Technical Reference manual Orcad and USA.

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**ELV3105 EMBEDDED AND REAL TIME SYSTEM**

Unit 1  
**Introduction to embedded systems:** Categories of embedded systems, overview of embedded system architecture; specialties of embedded systems recent trends in embedded systems, Communication interfaces: RS232/UART RS 422/RS485.

Unit 2  
**Survey of software Architectures:** Round Robin, Round Robin with interrupts, Function Queue scheduling Architecture,  RTOS Architecture, Architecture selection, Introduction to RTOS,- Task and task states, Task and data, Semaphore and shared data, More operating system services, - Message Queues, Mail boxes and pipes, Timer functions , events, Memory Management, Interrupt routine in an RTOS environment.

Unit 3  
**Basic Design using an RTOS:** Principle, Encapsulating Semaphores and Queues, Hard Real-Time scheduling considerations, saving memory space, saving power,

Unit 4  
**Embedded Software Development Tools:** Host and Target Machines, Linker/ Locator for Embedded Software, Getting Embedded Software into the target system, Debugging Techniques, Testing on your host machine, Instruction set Simulators, The Assert Macro using Laboratory tools.

Unit 5  
**Writing Software for Embedded Systems:** The compilation process, Native versus cross compilers, Run time libraries, Writing a library, Using alternative libraries, Using a standard library, Porting Kernels, C extensions for Embedded Systems, Downloading, Emulation and Debugging Techniques, Buffering and other data structures: What is a Linear buffer-Directional buffer, Double buffering, buffer exchanging, Linked lists, FIFO, Circular buffers, Buffer under run and overrun, Allocating buffer memory, memory leakage, Memory and performance trade offs

**TEXT BOOKS**


**REFERENCES**

Unit 1
**8-Bit Microcontrollers:** A popular 8-bit microcontroller, Architecture: CPU Block diagram, Memory organization, Program memory, Data memory, Interrupts, Peripherals: Timers, Serial port, I/O Port. Programming, Addressing Modes, Instruction Set, Programming, Comparison of various families of 8-bit Microcontrollers.

**16-Bit Microcontrollers:** A popular 16-Bit Microcontroller, Architecture: CPU Block diagram, Memory, Special function Registers. Comparison of different Microprocessor / Microcontroller architectures.

Unit 2
**16-Bit Microcontrollers Peripherals:** High speed input, High speed output, Interrupts, ADC, PWM, Timers, Watch-dog Timer, Serial port, I/O Port. Programming, Addressing Modes, Instruction Set, Programming, Comparison of various families of 16-bit Microcontrollers.

Unit 3
**Microcontroller based System Design:** Case study with reference to a popular 8/16-bit Microcontroller. A typical application design from requirement analysis through concept design, detailed hardware and software design using 8 and 16-bit Microcontrollers. Timing Analysis.

Unit 4
**Design, Development and Debugging Tools for Microcontroller based Systems:** Software tools like Cross assembler, compiler, debuggers, simulators and hardware tools like In-Circuit Emulators(ICE), Emulators, Logic Analyzers etc.

Unit 5
**PIC Microcontroller/ Any Advanced Controller:** CPU Architecture, Programming and peripheral details and application.

**TEXT BOOKS**

**REFERENCES**
ELV3107 DESIGN FOR TESTABILITY

Unit 1  
**Introduction to test and design for Testability Fundamentals:** Modeling: Modeling digital circuits at logic, register and structural models. Levels of Modeling, Logic Simulation- Types of simulation, Delay models, element evaluation, Hazard detection, Gate level event driven simulation, Logic Fault models, Fault detection and redundancy, Fault equivalence and fault location.

Unit 2  
**Testing for single Stuck Faults (SSF):** Automated test pattern generation (ATPG/ATG) for SSFs in combinational and sequential circuits, Functional Testing with specific fault models, Vector Simulation- ATPG Vectors, Formats, Compaction and Compression, Selecting ATPG Tools.

Unit 3  
**Design for Testability:** Testability trade offs and techniques Scan Architectures and testing- Controllability and observability, Generic Boundary scan, Full integrated scan, storage cells for scan design, Board level and system level DFT approaches, Boundary scan standards, Compression Techniques – Syndrome test band signature analysis.

Unit 4  
**Built in Self Test (BIST):** BIST concepts and test pattern generation, Specific BIST Architectures- CSBL, BEST,RTS, LOCST, STUMPS, CBIST, CBIS,RTD, SST, CATS, CSTP, BILBO. Advanced BIST concepts and design for self test at Board level

Unit 5  
**Memory BIST(M BIST):** Memory test Architectures and Techniques – Introduction to memory test, Types of memories and integration, embedded memory testing model, Memory test requirement for MBIST. Embedded core testing- Introduction to automatic in-circuit testing JTAG testing features.

**TEXT BOOKS**

**REFERENCES**
ELV3202 SYSTEM ON CHIP DESIGN

Unit 1


Unit 2

**Macro Design Process:** Top level Macro Design, Macro Integration, Soft Macro productization, Developing hard macros, Design issues for hard macros, Design, System Integration with reusable macros.

Unit 3

**SoC Verification:** Verification technology options, Verification methodology, Verification languages, Verification approaches, and Verification plans, System level verification, Block level verification, Hardware/software co-verification, and Static net list verification.

Unit 4

**Design of Communication Architectures For SoCs:** On chip communication architectures, System level analysis for designing communication, Design space exploration, Adaptive communication architectures, Communication architecture tuners, Communication architectures for energy/battery efficient systems.

Unit 5

**MPSoCs:** What, Why, How MPSoCs, Techniques for designing MPSoCs, Performance and flexibility for MPSoCs design, MPSoCs performance modeling and analysis, System-In-Package (SIP) design.

**TEXT BOOKS**


**REFERENCES**

2. “System-on-a-Chip-Design and Test”. Rochit Rajsuman, ISBN.
ELV3203 VLSI-DSP ARCHITECTURES

Unit 1
DSP Array processor architectures, fast convolution-Cook Toom algorithm, Winograd algorithm, Iterated convolution, Cyclic convolution, algorithmic strength reduction in filters and transforms, pipelined and parallel recursive and adaptive filters.

Unit 2
Scaling and round off noise, digital lattice filter structures, bit level arithmetic architectures, parallel multipliers, interleaved floor plan and bit plane based digital filters, bit serial multipliers, bit serial filter design and implementation.

Unit 3
Pipelining and parallel processing-pipelining of FIR digital filters, parallel processing, pipelining and parallel processing for low power, retiming, unfolding, folding transformation, register minimization techniques, Register minimization in folded architectures.

Unit 4
Synchronous wave and asynchronous pipelines, synchronous pipelining and clocking styles, clock skew and clock distribution in bit level pipelined VLSI design, wave pipelining, asynchronous pipelining.

Unit 5
Programmable Digital Signal Processors- DSP Processors for mobile and wireless communications, Processors for multimedia signal Processing, Multi Processor Systems

TEXT BOOKS


REFERENCES

Unit 1

Unit 2
**Custom Single purpose Processor**: RT-level combinational components, RT-level sequential components, Custom Single purpose Processor Design, RT-level Custom Single purpose Processor Design, Optimizing Custom Single-purpose Processors, Optimizing the original program, Optimizing the FSM, Optimizing the datapath, optimizing the FSM.

**General-purpose Processors**: Basic architecture, Datapath, Control unit, Memory, Pipelining, Superscalar and VLIW architectures. Application-Specific instruction-set Processors (ASIP’s), Micro-controllers, DSP, Less-General ASIP environments, Selecting a Microprocessor/General purpose Processor Design

Unit 3

Unit 4

Unit 5
**Control Systems**: Open-loop and closed-loop control systems, an open-looped automobile cruise-controller, a closed-loop automobile cruise-controller, General control systems and PID controllers, Control objectives, Modeling real physical systems, Controller design, Fuzzy control, Practical Issues Related to Computer based Control, Benefits of Computer Based Control Implementations.

**TEXT BOOKS**

**REFERENCES**
ELV3205 ADVANCED MICROPROCESSOR ARCHITECTURES

Unit 1
Introduction to general structure of advanced microprocessors, Discussions on bus architecture, instruction sets, interrupts, shared data problem, interrupt latency, memory hierarchy, pipelining and RISC principles.

Unit 2
Instruction Pipeline, Design consideration and performance models, Dependancy detection and resolution, Branch handling strategies, Static and dynamic pipeline, Scheduling techniques.

Unit 3
Vector processor, Memory-processor interface, vectorization techniques, Performance issues, Advanced Pipelined Processor, Superpipelined processor, Superscaled processor: Instruction scheduling, Software pipelining, VLIW.

Unit 4
Cache Memory, Organization, Cache addressing, Multilevel caches, Virtual Memory, Paged, segmented and paged organizations, Address translation: Direct page table translation, Inverted page table, Table look aside buffer, Virtual memory accessing rules.

Unit 5

TEXT BOOKS

REFERENCES
1. “Architecture of high performance computers”, Volume I- R N Ibbett and N P Topham
Unit 1

Unit 2
Basic IC Processing Steps: Oxidation, Diffusion, Ficks Laws, Sheet resistivity, Ion implantation, Basics of vacuum deposition, chemical deposition, high and low temperature pressure depositions, Etching techniques, standard bipolar NMOS and CMOS process sequences, techniques for process evaluation analysis, in process measurements.

Unit 3
CMOS System Design: CMOS memory design-SRAM and DRAM- general VLSI system components-arithmetic circuits in CMOS VLSI –Interconnects-resistive, capacitive,inductive parasitics-chip I/O design considerations.

Unit 4
Submicron Silicon Technology and Microprocessors: GaAs Technology, Impact of GaAs Technology on Microprocessor Architecture, Comparison between GaAs and Silicon technologies.

Unit 5
High Performance Digital Circuits: Domino and NORA logic- BiCMOS logic-static and dynamic behaviour-Delay in BiCMOs logic- Low power CMOS design.

TEXT BOOKS

REFERENCES
Unit 1
Introduction to High Speed Digital Design:- Frequencey, time and distance- Capacitance and Inductance Effects- High speed properties of logical gates- Speed and power- modeling of wires- Geometry and Electrical properties of wires- Electrical model of wires- transmission lines- lossless Lc transmission lines- lossy RLC transmission lines – Special transmission lines

Unit 2

Unit 3
Signalling convention and Circuits:- Signalling modes for transmission lines- Signalling over lumped transmission media- Signalling over RC interconnects- driving lossy LC lines- simultaneous bi-directional Signalling- terminators- transmitter and receiver circuits.

Unit 4

Unit 5
Ultra fast VLSI Circuits and Systems: GaAs crystal structure, Technology development, Device modeling and performance estimation, Thermal design, Electromagnetic compatibility

TEXT BOOKS

REFERENCES