AISECT UNIVERSITY
A STATUTORY UNIVERSITY UNDER SECTION 2(f) OF THE UGC ACT

# SCHEME OF EXAMINATION
# &
# DETAILED SYLLABUS

## MASTER OF TECHNOLOGY (EC)
## M. Tech (EC)

## VLSI DESIGN

## 2014-2015


Bhopal-Chiklod Road, Near Bangrasia Chouraha,
Vill-Mendua, Distt-Raisen(Madhya Pradesh), Ph:07480-295707
e-mail-info@aisectuniversity.ac.inwebsite: www.aisectuniversity.ac.in

## PROGRAMME OBJECTIVES

The Programme Educational Objectives of M. Tech programmes are:

1. To prepare graduates who will be successful professionals in industry, government, academia, research, entrepreneurial pursuit and consulting firms
2. To prepare graduates who will contribute to society as broadly educated, expressive, ethical and responsible citizens with proven expertise
3. To prepare graduates who will achieve peer-recognition; as an individual or in a team; through demonstration of good analytical, research, design and implementation skills
4. To prepare graduates who will thrive to pursue life-long reflective learning to full fill their goals

## PROGRAMME OUTCOMES

Engineering programmes have been designed to prepare graduates for attaining the following program outcomes:

1. an ability to apply knowledge of mathematics, science and engineering in practice
2. an ability to identify, critically analyze, formulate and solve engineering problems with comprehensive knowledge in the area of specialization
3. an ability to select modern engineering tools and techniques and use them with dexterity
4. an ability to design a system and process to meet desired needs within realistic constraints such as health, safety, security and manufacturability
5. an ability to contribute by research and innovation to solve engineering problems
6. an ability to devise and conduct experiments, interpret data and provide well informed conclusions
7. an ability to understand the impact of engineering solutions in a contemporary, global, economical, environmental, and societal context for sustainable development
8. an ability to function professionally with ethical responsibility as an individual as well as in multidisciplinary teams with positive attitude
9. an ability to communicate effectively
10. an ability to appreciate the importance of goal setting and to recognize the need for life-long reflective learning

## PROGRAMME SPECIFIC OBJECTIVES

1. To educate and train the graduates with knowledge and skills necessary to formulate, design and solve problems in Analog, Digital & Mixed Signal VLSI system design, VLSI Signal Processing, Real Time Embedded System design and Hardware Software Co-Design.
2. To provide technical skills in software and hardware tools related to the design and implementation of integrated Circuits, System on Chip for real time applications.
3. To provide scope for Applied Research and innovation in the various fields of VLSI and Embedded Systems, and enabling the students to work in the emerging areas.
4. To enhance communication and soft skills of students to make them work effectively as a team.
5.

## PROGRAMME SPECIFIC OUTCOMES

On completion of the program, the graduates will

1. Be able to analyze, design and implement Analog, Digital and Mixed Signal Circuits and real time embedded systems.

2. Have in-depth knowledge and capability to use industry standard tools in the design and implementation of VLSI and real time Embedded Systems.
3. Be able to undertake research projects in related domains of VLSI and Embedded systems.
4. Possess the capability to communicate effectively and work as a team in the professional career.

# AISECT UNIVERSITY, Bhopal, (M.P.)
## Scheme of Examination

**Department: Electronics and communication Engineering**

| Subject Code | Subject Name | Credits | Maximum marks Allotted | | | | | | Duration of Exam. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Theory | | | Practical | | Total | Theory | Practical |
| | | | Major | Minor | Sessional. | End Sem | Lab Work | | | |
| MEVD-101 | Advanced mathematics | 4(3+1+0) | 50 | 20 | 30 | - | - | 100 | 3 hr | - |

**Course Objective:**
To provide the student with the concept and the understanding of basics in Partial Differential Equations and Transform. The objective of this course is to fulfil the needs of Engineers to understand the Applications of probability, stochastic process, Queuing system, fuzzy sets and reliability Techniques in order to acquire Mathematical knowledge and to Solving a wide range of Practical Problems

**UNIT - I**
Solution of Partial Differential Equation (PDE) by separation of variable method, Numerical solution of PDE (Laplace, Poisson's, Parabola) using finite difference Methods, Elementary properties of FT, DFT, WFT, Wavelet transform, Haar transform.

**UNIT – II**
Probability, compound probability and discrete random variable. Binomial, Normal, Poisson's distribution. Sampling distribution, elementary concept of estimation and theory of hypothesis, recurred relations.

**UNIT - III**
Stochastic process, Markov process transition probability transition probability matrix, Just and higher order Markov process, Markov chain. Queuing system, transient and Steady state, traffic intensity, distribution queuing system, concepts of queuing models (M/M/1: Infinity/ Infinity/ FC FS), (M/M/1: N/ Infinity/ FC FS), (M/M/S: Infinity/ Infinity/ FCFS)

**UNIT – IV**
Operations of fuzzy sets, fuzzy arithmetic & relations, fuzzy relation equations, fuzzy logics. MATLAB introduction, programming in MATLAB scripts, functions and their Application.

**UNIT –V**
Introduction and definition of reliability, derivation of reliability functions, Failure rate, Hazard rate, mean time t future & their relations, concepts of fault tolerant analysis, Elementary idea about decision theory and goal programming.

**Course Outcome:**
Knowledge in the technical, methodology of solving Partial Differential Equations. A basic understanding in the Transforms which are useful in solving engineering problems. The curriculum of the Department is designed to satisfy the diverse needs of students. Coursework is designed to provide students the opportunity to learn key concept of Applications of probability, stochastic process, Queuing system, fuzzy sets and reliability

**REFERENCES:**

1. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Hill.
2. Advance Engineering Mathematics by Ervin Kreszig, Wiley Easten Edd.
3. Applied Numerical Methods with MATLAB by Steven C Chapra, TMH.
4. Introductory Methods of Numerical Analysis by S.S. Shastry,
5. Introduction of Numerical Analysis by Forberg
6. Numerical Solution of Differential Equation by M. K. Jain
7. Numerical Mathematical Analysis by James B. Scarborogh
8. Fourier Transforms by J. N. Sheddon
9. Fuzzy Logic in Engineering by T. J. Ross
10. Fuzzy Sets Theory & its Applications by H. J. Zimmersoms

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| MEVD-102 | CMOS VLSI Design | 4(3+1+0) | 50 | 20 | 30 | - | - | 100 | 3 hr | - |

**Course Objective**

1. Introduce the technology, design concepts, electrical properties and modelling of Very Large Scale Integrated circuits.
2. Basics of MOS Circuit Design & modelling
3. Basics of MOS process Technology
4. Understand the concepts of modelling a digital system using Hardware Description Language.

**UNIT – I**

**VLSI design methodologies:** VLSI Design flow, Design Hierarchy, Regularity, Modularity and Locality, VLSI design styles, Design quality, Packaging technology MOS device design equations, Second order effects, the complementary CMOS Inverter DC characteristics.

**UNIT – II**

**Circuit Characterization and Performance Estimation:** Parasitic effect in Integrated Circuits, Resistance estimation, capacitance estimation, Inductance. Switching characteristics, CMOSGate transistor sizing, Power dissipation, CMOS Logic Structures, Clocking Strategies.

**UNIT – III**

**CMOS Process Enhancement and Layout Considerations:** Interconnect, circuit elements, Stick diagram, Layout design rules, Latchup, latchup triggering, latchup prevention, Technology related CAD issues.

**UNIT – IV**

**Subsystem Design:** Structured design of combinational logic- parity generator, multiplexer, code converters. Clocked sequential circuits- two phase clocking, charge storage, dynamic register element, and dynamic shift register. Subsystem design process, Design of ALU subsystem, Adders, Multipliers. Commonly used storage/ memory elements.

**UNIT –V**

**Field Programmable Devices**: Definitions of Relevant Terminology, Evolution of Programmable Logic Devices, User- Programmable Switch Technologies, Computer Aided Design (CAD) Flow for FPDs, Programmable Logic, Programmable Logic
Structures, Programmable Interconnect, Reprogrammable Gate Array, Commercially Available SPLDs, CPLDs and FPGAs, Gate Array Design, Sea-of-Gates.

**Course Outcomes**

1. Students will demonstrate knowledge of mathematics, science and engineering.
2. Students will demonstrate the ability to identify, formulate and solve engineering problems.
3. Students will demonstrate the ability to design and conduct experiments, analyze and interpret data
4. Students will demonstrate the ability to design a system, component or process as per needs and specifications.
5. Students will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues

**REFERENCES:**

1. D.A. Pucknell, K. Eshraghian, *Basic VLSI Design*, PHI, 3rd Ed.
2. John P. Uyemura, *Introduction to VLSI Circuits and Systems*, John Wiley & Sons.
3. Niel H.E. Weste, K. Eshraghian,, *Principles of CMOS VLSI Design*, Person, 2nd Ed.
4. Mead and L. Conway, *Introduction to VLSI Systems,* Addison-Wesley.
5. A. Mukherjee, *Introduction to nMOS and CMOS VLSI systems design,* Prentice Hall.

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| MEVD-103 | Advanced logic design | 6(3-2-1) | 50 | 20 | 30 | 25 | 25 | 150 | 3 hr | 2 hr |

**Course Objective**

Advanced techniques in the design of digital systems. Hardware description languages, combinational and sequential logic synthesis and optimization methods, partitioning, mapping to regular structures. Emphasis on reconfigurable logic as an implementation medium. Memory system design. Digital communication including serial/parallel and synchronous/asynchronous methods.

**UNIT – I**

Course overview; design concepts, introduction to logic circuit and Verilog. Implementation technology, CMOS logic gates, programmable logic devices. Optimized implementations of logic functions, canonical representations Karnaugh maps, factoring, functional decomposition, NAND/NOR networks, bubble pushing.

**UNIT – II**

Verilog data types and operators, modules and ports, gate level modeling, time simulation/ scheduler. Circuit issues. Verilog behavioral models, number representation and arithmetic circuits, positional notation, signed numbers, arithmetic operations.

**UNIT – III**

Verilog specifications of combinational circuits, combinational logic building blocks, encoders/decoders, arithmetic comparison, etc. The basic latch, gated SR and D latch, master-slave and edge-triggered flip flops, counters, shift registers, Design examples, introduction to finite state machines; introduction to ModelSim.

**UNIT – IV**

Synchronous sequential circuits, design process, state assignment, hazards, glitches, asynchronous design, Metastability, Noise margins, Power, fan-out, skew Finite state machine design examples, Verilog representations.

**Course Outcomes**

1. an ability to apply knowledge of mathematics, science, and engineering
2. an ability to design and conduct experiments, as well as to analyze and interpret data
3. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4. an ability to identify, formulate, and solve engineering problems
5. an ability to use the techniques, skills, and modern engineering tools a recognition of the need for, and an ability to engage in life-long learning

**REFERENCES:**

1. John F. Wakerly, *Digital Design*, Pearson Education Asia, 3rd Ed.
2. M. M. Mano, *Digital Design*, Pearson Education, 3rd Ed.
3. C. H. Roth, Jr., *Fundamentals of Logic Design*, Jaico Publishing House.
4. Fletcher, *An Engineering Approach to Digital Design*, PHI.
5. J. M. Yarbrough, *Digital Logic*, Thomson Learning.
6. Stephen Brown and Zvonko Vranesic, *Fundamentals of Digital Logic with Verilog Design*, McGraw-Hill Higher Education, 2003, ISBN 0-07-283878-7.
7. Samir Palnitkar, *Verilog HDL*, Prentice Hall, 2nd Edition, 2003, ISBN 0-13-044911

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| MEVD-104 | Digital signal processing | 6(3-2-1) | 50 | 20 | 30 | 25 | 25 | 150 | 3 hr | 2 hr |

**Course Objective:** This course will introduce the basic concepts and techniques for processing signals on a computer. By the end of the course, you be familiar with the most important methods in DSP, including digital filter design, transform-domain processing and importance of Signal Processors. The course emphasizes intuitive understanding and practical implementations of the theoretical concepts.

**UNIT – I**

**Introduction to Discrete Time Signals** Sequences; representation of signals on orthogonal basis; Sampling and Reconstruction of signals.

**UNIT – II**

**Discrete Systems**

Attributes; Z-Transform; Analysis of LSI systems; Frequency analysis; Inverse systems, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithms, Implementation of discrete time systems.

**UNIT – III**

**Design of FIR Digital Filters** Window method, Park-McClellan's method; Effect of finite register length in FIR filter Design.

**UNIT – IV**

**Design of IIR Digital Filters**

Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters.

**UNIT –V**

**Introduction to VLSI DSP**

Transformations for high speed using pipelining, retiming, parallel processing, and folding techniques; Design of programmable DSPs.

**Course Outcomes:** By the end of the course the student will be able to:

1. Represent discrete-time signals analytically and visualize them in the time domain.
2. Understand the meaning and implications of the properties of systems and signals.
3. Understand the Transform domain and its significance and problems related tom computational complexity.
4. Be able to specify and design any digital filters using MATLAB.

**REFERENCES:**

1. A.V. Oppenheim and Schafer, *Discrete Time Signal Processing*, Prentice Hall, 1989.
2. John G. Proakis and D.G. Manolakis, *Digital Signal Processing: Principle, Algorithms and Applications*, Prentice Hall, 1997.
3. L.R. Rabiner and B. Gold, *Theory and Application of Digital Signal Processing*, Prentice Hall, 1992.
4. J.R. Johnson, *Introduction to Digital Signal Processing*, Prentice Hall, 1992.
5. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, *Digital Signal Processing*, J Wiley and Sons, Singapore, 1988.
6. K.K. Parhi, *VLSI Digital Signal Processing Systems: Design and Implementation*, Wiley.

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| MEVD-105 | Embedded Microcontrollers Programming | 4(3+1+0) | 50 | 20 | 30 | - | - | 100 | | - |

**Course Objective:**

1. Recognize and identify the constraints facing embedded system designers, and determine How to assess them.
2. Program a modern microcontroller in assembly language and operate its peripheral devices.
3. Interpret how the assembly code generated by a compiler relates to the original C code.
4. Practice thread-based program design.
5. Develop programs controlling embedded systems using quick and efficient methods.
6. Predict measure and manipulate a program's execution time.

**Syllabus**

**UNIT – I**

Embedded System Overview : Embedded System definition. Processor Technology : General purpose, Single Purpose, Application Specific, Super scalar, Pipelined, Very Long Instruction Word (VLIW) Processor, Microprocessors, Micro controllers and DSP Processors. Embedded Processors in VLSI circuit.

**UNIT – II**

Architectural Issues: CISC, RISC, DSP and Harvard/Princeton Architectures. Memory: ROM, EPROM, EEPROM, FLASH, RAM, SRAM, DRAM, SDRAM, NVRAM, EDORAM, DDRRAM, Memory Hierarchy and Cache. Interfacing: Interfacing using Glue Logic, Interrupt, DMA, I/O Bus structure, I/O devices, Serial Communication Protocols, Parallel Communication Protocols, Wireless Protocols.

**UNIT – III**

Introduction to 8-bit Microcontrollers e.g. 8051, 68HC11, 80196, Timers/Counters, USART. Detailed study of 8051 microcontroller, with its programming in assembly language and Interrupts, Serial Programming etc.

**UNIT – IV**

Interfacing of Microcontroller such as SPI, PWM, WDT, Input Capture, Output Compare Modes, Interfacing LED, Switches, ADC, DAC, LCD , RTC. Idea about the C programming of Microcontroller. I2C, CAN bus architecture.

**UNIT –V**

Introduction to 16/32-bit microcontrollers. Introduction to ARM Architecture and Organization, Difference between ARM7 , ARM9 & ARM11 TDMI, ARM programming model, ARM Instruction set.

**Course Outcomes**

1. Understand what is a microcontroller, microcomputer, embedded system.
2. Understand different components of a micro-controller and their interactions.
3. become familiar with programming environment used to develop embedded systems
4. Understand key concepts of embedded systems like IO, timers, interrupts, interaction with peripheral device
5. Learn debugging techniques for an embedded system.

**REFERENCES:**

1. David E. Simon, *An Embedded Software Primer*, Pearson Education.
2. Dr. RajKamal, *Embedded Systems*, TMH.
3. Vahid & Givargis, *Embedded System Design*,John Wiley & Sons.
4. K. J. Ayala , *8051 Microcontrollers*, Penram International, Second Edition
5. M. A. Mazidi & J. G. Mazidi, *8051 Microcontroller and Embedded System*, Pearson Education Asia
6. J. W. Valvano, *Embedded Microcomputer Systems - Real Time Interfacing*, Thomson Asia Pte. Ltd.
7. R. H. Barnett, *8051 family of Microcontrollers*, PHI.
8. Peter Spasov, *Microcontroller Technology: The 68HC11*, PHI, Fourth Edition
9. Dr. Rajkamal, *Microcontrollers (Architecture, Programming, Interfacing and System Design)*, Pearson Education.

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| MEVD-201 | VLSI Technology | 4(3+1+0) | 50 | 20 | 30 | - | - | 100 | 3 hr | - |

**Course Objective:**
The course is designed to give the student an understanding of the different design steps required to carry out a complete digital VLSI (Very-Large-Scale Integration) design in silicon.

**UNIT – I**
**Overview of Semiconductor Processing:** Electronic grade silicon preparation, Crystal growth, Czochralski process,wafer-preparation, slicing, Marking, polishing, evaluation. Basic wafer fabrication operations, wafer sort, clean room construction and maintenance.

**UNIT – II**
**Oxidation:** Objectives, Silicon dioxide layer uses, Thermal oxidation mechanism and methods,Kinetics of oxidation, Deal Grove model, Oxidation processes, post oxidation evaluation.

**UNIT – III**
**Basic Patterning:** Overview of Photo-masking process, Ten step process, Basic photo resist chemistry, comparison of positive and negative photo resists, X-ray lithography, Electron beam exposure system.

**UNIT – IV**
**Doping:** Definition of a junction, Formation of doped region and junction by diffusion, diffusionprocess steps, deposition, drive-in-oxidation, Ion implantation- concept and system, implant damage, Comparison of diffusion and ion-implantation techniques.

**UNIT –V**
**Deposition:** Chemical Vapor Deposition (CVD), CVD Process steps, CVD System types, Low-Pressure CVD (LPCVD), Plasma-enhanced CVD (PECVD), Vapor Phase Epitaxy (VPE), Molecular Beam Epitaxy (MBE), Metalorganic CVD (MOCVD), SOS (Silicon on Sapphire) andSOI (silicon on Insulator). Brief Introduction to Metallization.

**Course Outcomes:**
1. Be able to use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect.
2. Be able to create models of moderately sized CMOS circuits that realize specified digital functions.
3. Be able to apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects.
4. Have an understanding of the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes.
5. Be able to complete a significant VLSI design project having a set of objective criteria and design constraints.

**REFERENCES:**

1. S.M. Sze, *VLSI Technology*, McGraw-Hill, 2nd Ed.
2. S. K. Gandhi, *VLSI Fabrication Principles*, Wiley
3. W. R. Runyan, *Silicon Semiconductor Technology*, McGraw-Hill.

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| MEVD-202 | Real time operating system | 4(3+1+0) | 50 | 20 | 30 | - | - | 100 | 3 hr | - |

**Course Objective:**
To introduce the basic concepts of Embedded Systems and the various techniques used for Embedded Systems with real time examples.

**UNIT – I**
Introduction to OS, Process Management & Inter Process Communication. Memory management, I/O subsystem, File System Organization.

**UNIT – II**
**(a)** Real Time Systems Concepts: Foreground/Background Systems, Critical Section of Code, Resource, Shared resource, Multitasking, task, context switch, Kernel, Schedules, Primitive & Non-Primitive Kernel, various scheduling methods.
**(b)** Real Time Scheduling. Real-Time task scheduling: Clock-driven, Event-driven, Scheduling of real-time task on a uniprocessor. Rate Monotonic Analysis (RMA), Earliest Deadline First (EDF), and Scheduling with limited priority levels

**UNIT – III**
Kernel structure, Task scheduling, Task management, Resource sharing among tasks, Priority inversion problem, Priority inheritance protocol An overview of scheduling in multiprocessor and distributed systems

**UNIT – IV**
Performance Metrics of RTOS, Programming in VxWorks, or COS-II Overview of C/OS-Overview of some other commercial embedded operating systems: PSOS, VRTX, RT Linux, WinCE. Benchmarking real-time operating systems.

**UNIT –V**
Commercial real-time operating systems: Unix as a real-time operating system, Windows as a real-time operating system, Extensions to Unix : Host target approach, Preemption points, Fully preemptable kernel

**Course Outcomes:**
1. To discuss the basics o embedded systems and the interface issues related to it.
2. To learn the different techniques on embedded systems.
3. To discuss the real time models, languages and operating systems.
4. To analyze real time examples.

**REFERENCES:**

1. Jean J. Labrosse, MicroC/OS-II, The Real Time Kernel
2. VxWorks details from Internet.
3.C/OS-II Manuals
4. David E. Simon, A*n Embedded Software Primer*, Pearson Education
5. Dr. Rajib Mall, Real time Systems, Theory and practices, Pearson Education.

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| | | | Major | Minor | Sessional. | End Sem | Lab Work | | | |
| MEVD-203 | VLSI TEST AND TESTABILITY | 4(3+1+0) | 50 | 20 | 30 | - | - | 100 | 3 hr | - |

**Course Objective**
The objective of this course is to provide students with a sound knowledge of VLSI systems covering the following:
1. Processor architectures, memory organization and performance analysis, and concepts and techniques for parallel processing and pipeline processing.
2. High-speed synchronization design and system noise consideration.
3. VLSI system design verification and testability, and system reliability.

**UNIT – I**
**Introduction to Testing Process:**
CMOS Testing, Reliability, Failures & Faults, Levels of Testing, Test economics, Elementary Testing Concepts, System and Field Testing, Burn in boards.

**UNIT – II**
**Logic Simulation & Fault modelling**: Delay Models, Event driven simulation, general fault emulation, fault detection and redundancy, fault equivalence and fault dominance. Stuck-at faults, bridging faults, transistor faults, delay faults etc. Fault detection using Boolean Difference, Path Sensitization. Fault Collapsing

**UNIT – III**
**Test generation for combinational & sequential circuits**: D-algorithm, PODEM, SPOOF. Automatic Test Pattern Generation. Primitive and Propagation Cubes. Fan-out Oriented Test Generation. Controllability and Observability. Testing of sequential circuits as iterative combinational circuits, state table verification, random testing.

**UNIT – IV**
**Design for testability**: Ad-hoc methods, Full scan & Partial scan design. Boundary scans.
Testability analysis.

**UNIT –V**
**Built-in self-test & IDDQ testing**: RAM BIST, Logic BIST Random and weighted random pattern testability BIST Pattern generator and response analyzer Scan-based BIST architecture Test point insertion for improving random testability. IDDQ testing, IDDQ test patterns, IDDQ measurement Case studies, Design for IDDQ testability

**Course outcomes**

After the completion of this course, the students are able to:

1. Acquire knowledge about fault modeling and collapsing.
2. Learn about various combinational atpg.
3. Understand sequential test pattern generation.
4. Use various verification techniques.

**REFERENCES:**


1. Parag K. Lala, *Fault Tolerant and Fault Testable Hardware Design*, BS Publication.
2. N. Weste and K. Eshraghian, *Principles of CMOS VLSI design*, Addison-Wesley.


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| | | | Major | Minor | Sessional. | End Sem | Lab Work | | | |
| MEVD-204 | Micro electronics | 4(3+1+0) | 50 | 20 | 30 | - | - | 100 | 3 hr | - |

**Course Objective**

1. Understand how to approach analysis and design of circuits with nonlinear elements, including diodes, BJTs and MOSFETs, with an emphasis on design oriented analysis techniques.
2. Understand the principles of operation for pn junctions, semiconductor diodes, MOSFETs and BJTs, including intuition behind the physical meaning of device model parameters and limitations of models.
3. Understand how to analyze and design basic amplifier gain stages and digital logic gates using MOSFETs and BJTs.

**UNIT – I**
Review of quantum mechanics theory. Motion of electron in a periodic lattice. Band theory of solids, effective mass, holes.

**UNIT – II**
Statistics of carriers in semiconductors. Lifetime and recombination theory. Boltzmann transports equation. Carrier transport in semiconductors, including high field effect.

**UNIT – III**
P-N junction theory. Excess currents and breakdown in p-n junctions. Bipolar transistors. Ebers-Moll and small signal models. Switching characteristics. Non uniformly doped transistors. High current and high frequency effects.

**Course Outcome**

After taking this course students will be able to recognize and use the following concepts, ideas, and/or tools:

1. Small-signal analysis of circuits with diodes, MOSFETs and BJTs
2. Large-signal analysis of circuits with diodes, MOSFETs and BJTs
3. Design oriented analysis of microelectronic electronic circuit

**REFERENCES:**

1. J.L. Moll, *Physics of Semiconductors*, McGraw Hill
2. F.Y. Wang, *Introduction to Solid State Electronics*, North Holland.
3. S.M. Sze, *Physics of Semiconductor Devices*, Weiley Easter.
4. D.J. Roulston, *Dipolar Semiconductors Devices*, McGraw Hill
5. R.L. Pritchnard, *Electrical Characteristics of Transistors*, McGr

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| | | | Major | Minor | Sessional. | End Sem | Lab Work | | | |
| MEVD-205 | Embedded Computing System Design | 6(3-2-1) | 50 | 20 | 30 | 25 | 25 | 150 | 3 hr | 2 hr |

**Course Objectives** Main objectives of the course are:
1. Introduction of the real-time systems.
2. Computing required for the real-time embedded systems.
3. Communication required for the real-time embedded systems.
4. Present an overview of the real-time embedded systems in practice.

**UNIT – I**
Introduction: Embedding Complex Systems and Microprocessors Embedded System Design Process, Designing Hardware and Software Components, Formalization of System Design, Application Examples.

**UNIT – II**
Instruction Sets: Assembly Language, ARM processor and memory organization. Data Operations and Control of Flow. SHARC Processor, Memory organization, Data Operations and flow control, Parallelism within the instructions.

**UNIT – III**
CPUs: Performance, Power Dissipation, Design Example, Data Compression. CPU Bus Protocols in ARM, Design, Development and Debugging.

**UNIT – IV**
Program design and Analysis: Program Design, Models of Program, Assembling, Linking, Compiling, Analysis and optimization of the Program Size and Execution times. Design Example: Software Modem.

**UNIT –V**
System Design Techniques: Design Methodologies, Requirement Analysis, Specifications, System Analysis, quality Assurance, Two Design Examples inNetworking and Internet Enabled Systems and Automobile Applications.

**Course Outcomes**
After succefully completing these course students shall be able:
1. To present the mathematical model of the system.
2. To develop real-time algorithm for task scheduling.
3. To understand the working of real-time operating systems and real-time database.
4. To work on design and development of protocols related to real-time communication.

**REFERENCES:**

1. Wayne Wolf, *Computers as Components*, Harcourt India Private Ltd.

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# AISECT UNIVERSITY, Bhopal, (M.P.)
## Scheme of Examination

**Department: Electronics and communication Engineering**

| Subject Code | Subject Name | Credits | Maximum marks Allotted | | | | | | Duration of Exam. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Theory | | | Practical | | Total | Theory | Practical |
| | | | Major | Minor | Sessional. | End Sem | Lab Work | | | |
| MEVD-301 | Opto-Electronics Integrated Circuits | 4(3+1+0) | 50 | 20 | 30 | - | - | 100 | 3 hr | 2 |

**Course Objective** This course provides a complete overview of the wide variety of different semiconductor optoelectronic devices employed in light wave systems and networks. Topics include a variety of different subjects including a detailed discussion of the design and operation of optical LEDs, the basic physics and operation of lasers and photo detectors, details of the basic physics and operation of solar cells, the operation of quantum well electro-absorption modulators and electro-optic modulators, and the design and operation of optoelectronic integrated circuits. Emphasis is on the underlying device physics behind the operation and design of optoelectronic devices.

**UNIT – I**

**Theory of Optical Wave guides:** Wave guide theory: one dimensional planar wave guides, two dimensional wave guides, transcendental equations, wave guide modes, mode cut off conditions.

**UNIT – II**

**Optical Wave guide Fabrication and Characterization:** Waveguide fabrication: deposited films; vacuum-deposition and solution-deposition, diffused waveguides, ion-exchange and ion-implanted waveguides, epitaxial growth of III-V compound semiconductor materials,
shaping of waveguides by wet and dry etching techniques. Waveguide characterization: surface scattering and absorption losses, radiation and bending losses, measurement of waveguide loss, waveguide profiling.

**UNIT – III**

**Fundamentals of Optical Coupling:** Transverse couplers. Prism couplers. Grating couplers. Fiber to waveguide couplers. Coupling between optical waveguides. Directional couplers. Applications of directional couplers.

**UNIT – IV**

**Guided Wave Modulators and Switches:** Physical effects used in light modulators: electro-optic, acousto-optic and magneto-optic effects. Waveguide modulators and switches.

**UNIT –V**

**Semiconductor Lasers and Detectors:** Laser diodes. Distributed feedback lasers. Integrated optical detectors.

**Unit VI**

**Recent Progress in Integrated Optics:** State-of-the-art technology in guided wave devices and applications, e.g. photonic switching, tunable laser diodes, optical integrated circuits.

**Course Outcomes**

1. Acquire fundamental understanding of the basic physics behind optoelectronic devices.
2. Develop basic understanding of light emitting diodes.
3. Develop detailed knowledge of laser operating principles and structures.
4. Acquire in depth understanding of photo detectors.
5. Acquire detailed knowledge of solar cells and optoelectronic modulation and switching devices.
6. Develop basic understanding of optoelectronic integrated circuits.

**REFERENCES:**

1. T Tamir, *Guided Wave Optoelectronics*, Springer-Verlag, 1990
2. R Sysm & J Cozens, *Optical Guided Waves and Devices*, McGraw-Hill, 1993

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|---|---|---|---|---|---|---|---|---|---|---|
| | | | Theory | | | Practical | | Total | Theory | Practical |
| | | | Major | Minor | Sessional. | End Sem | Lab Work | | | |
| MEVD-302 | System on Chip (SOC) Design | 6(3-2-1) | 50 | 20 | 30 | 25 | 25 | 150 | 3 hr | 2 hr |

**Course Objective**

1. To design combinational logic functions and analyze delay and testability properties of interconnect and gates.
2. To learn optimization of power in sequential logic machines
3. To study the design principles of FPGA and PLA.
4. To learn various floor planning methods for system design.

**UNIT – I**

Recent advances in semiconductor technology, Programmable logic devices, such as field programmable gate arrays (FPGAs), Programmable chip architectures, logic synthesis, SoC concepts, and the Verilog synthesizable subset, Implementation of a complex system on a single programmable chip.

**UNIT – II**

Tools and techniques for designing, verifying and implementing System-on-Chip (SoC) designs using programmable logic. Embedded system applications and their system-level hardware-software co-design.

**UNIT – III**

Implementation Aspects: Adders, ALUs, Multipliers, Dividers, Register Files, Buses, CISC/RISC, Memory hierarchy (caches, MMU, main memory)

**UNIT – IV**

ARM System-on-chip architecture.

**UNIT –V**

**Project Orientation:** Concept to Verilog hardware description language (HDL), verification using simulation, synthesis and programmable device implementation on an FPGA development board.

**Course Outcomes**

1. To design, logic gates with minimum size, spacing, and parasitic values.
2. To design combinational logic machines with optimum power
3. To design sequential logic machines with optimum power
4. To study the design principles of FPGA and PLA.
5. To learn various floor planning methods for system design

**REFERENCES:**


1. Palnitkar, Samir, Verilog HDL, Prentice Hall, 2003, 2nd Ed., ISBN 0-13-044911-3
2. Bhasker, J., Verilog HDL Synthesis – A Practical Primer, Star Galaxy Publishing, Allentown PA, 1998, ISBN 0-9650391-5-3
3. Maxfield, Clive, The Design Warrior's Guide to FPGAs, Newnes, 2004, ISBN 0-7506-7604-3
4. Smith, D. J., HDL Chip Design, Doone Publications, Madison AL, 1999, ISBN 0-9651934-3-8
5. Sutherland, Stuart, Verilog 2001 – A Guide to the New Features of the Verilog Hardware
6. Description Language, Kluwer Academic Publishers, 2002, ISBN 0-7923-7568-8
7. Cummings, C., Nonblocking Assignments in Verilog Synthesis, Coding Styles That Kill, Synopsys Users Group 2000
8. Cummings, C., "full_case parallel_case", the Evil Twins of Verilog Synthesis, Synopsys Users Group 1999
9. Mills, D., Cummings, C., RTL Coding Styles That Yield Simulation and Synthesis Mismatches, Synopsys Users Group 1999
10. Xilinx Spartan-3 FPGA Family Data Sheet, DS099-2
11. Xilinx PicoBlaze KCPSM3 Microcontroller Users Manual


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| | | | Theory | | | Practical | | Total | Theory | Practical |
| | | | Major | Minor | Sessional. | End Sem | Lab Work | | | |
| MEVD-303 | Communication RF IC Design | 4(3+1+0) | 50 | 20 | 30 | - | - | 100 | 3 hr | - |

**Course Objective**

The objective of this course is to present the concepts of design and analysis of modern RF and wireless communication integrated circuits. Topics covered are: basic concepts in RF design, scattering parameters, modern integrated circuit technologies, fundamental limitations of speed of operation of transistors, physics of noise, impedance matching, low-noise amplifiers, mixers, oscillators, phase noise, and phase locked loops.

**UNIT – I**

Basic concepts in RF Design: Analysis & Measurement Techniques. S-Parameter Models, Smith Chart Calculations.

**UNIT – II**

Trans-receiver Architecture for Wireless Communication Standards. Non-Linearity, Harmonics, Gain Compression, Desensitization, Cross Modulation, IMD & Inter-symbol Interface.

**UNIT – III**

RF IC Design concepts & Device Technologies: Low Noise Amplifiers, Mixers, Frequency Sources, Oscillators & Synthesizers, Power Amplifiers. Noises & Distortions in LNA, PA & Mixer Circuits.

**UNIT – IV**

PLL: Theory, Circuits, Distortion & Noises. Microwave Circuit Components & Design Concepts: Single Chip Radio Concepts, Design Issues Surrounding Systems as DECT, GSM, Blue Tooth etc. Case Studies.

**Course Outcomes**

It is expected that the students be able to apply the concepts and design techniques presented in this course to a wide range of applications including high-speed wireless communications and biomedical electronics.

**REFERENCES:**


1. Behzad Razavi, *RF Microelectronics*, PHI 1998.
2. R. Ludwig & P. Bretchko, *RF Circuit Design,* PHI 2000.
3. L.E. Larson, *RF & Microwave Circuit Design for Wireless Communication,* Artech House Publishers, 1997

4. Thomas H. Lee, *The Design of CMOS Radio Frequency Integrated Circuits*, Cambridge University Press, 1998.
5. George Vendelin, *Design of Amplifiers & Oscillators by S-Parameter Method*, J. Wiley & Sons, 1982

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| | | | Theory | | | Practical | | Total | Theory | Practical |
| | | | Major | Minor | Sessional. | End Sem | Lab Work | | | |
| MEVD-304 | Embedded System Programming | 4(3+1+0) | 50 | 20 | 30 | - | - | 100 | 3 hr | - |

**Course Objective:** To understand the basic concepts of embedded system, understanding of different types of programming languages used for embedded systems. Study of ARM based processors: architecture, programming and interfacing of ARM processor with memory & I/O devices. To discuss the features, Architecture and programming of Arduino Microcontroller, Architecture of Arduino. To study of RTOS.

**UNIT – I**
Introduction to Linux Operating System. Shell Programming, Review of C-Programming and Data Structures.

**UNIT – II**
Overview of Embedded Systems – Sequential and Concurrent Models – Processor Solutions and Types – Types of Memory – Data Representation Formats – Usage of C in Embedded Systems – Programmers view of CPU – IO programming models – Concurrent Software Design – Scheduling – Memory Management – Mixing C & Assembly.

**UNIT – III**
Embedded System Design Issues , Challenges & Trends in Embedded Systems, Assemblers, Compilers, Linkers, Loaders, Debuggers , Profilers & Test Coverage Tools , Utilities like make, ranlib, objcopy & objdump etc.

**UNIT – IV**
Writing device drivers, Writing Time & Space Sensitive Programs, Programming in C for 8051, 68HC11 and 80196 microcontrollers.

**Course Learning Outcomes(CLOs):**
1. Understanding of Embedded system, programming, Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits.
2. Understanding of internal Architecture and programming of ARM processor.
3. Programming concepts of Arduino Microcontroller with various interfaces like memory & I/O devices and Raspberry Pi based embedded platform.
4. Need of Real Time Operating System (RTOS) in embedded systems.
5. Study of Real Time Operating system with Task scheduling and Kernel Objectives.

REFERENCES:

1. David E. Simon, An Embedded Software Primer, Pearson Education.
2. Michel Barr, Programming Embedded Systems in C & C++, Shroff Publishers & Distributors Pvt. Ltd.
3. Frank Vahid and Tony Givargis, Embedded System Design: A Unified Hardware/Software Introduction, John Wiley & Sons, 2002.
4. Daniel W. Lewis, Fundamentals of Embedded Software: Where C and Assembly Meet, Prentice Hall, 2002.
5. Jane Liu, Real-time Systems, Prentice Hall, 2000.

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